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Tacoma, Wash., Jan. 6 1891.

To I. C. Russell

I take pleasure in presenting this, the first annual report upon the Mines and Minerals of Washington.

Yours very truly,

GEO. A. BETHUNE,
First State Geologist.

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Mines and Minerals of Washington.

ANNUAL REPORT

OF

GEORGE A. BETHUNE,

FIRST STATE GEOLOGIST.

OLYMPIA, WASH.:
O. C. WHITE, STATE PRINTER.
1891.

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ANNUAL REPORT.

To his Excellency, CHARLES E. LAUGHTON, *Governor, and the honorable, the members of the Senate and House of Representatives of the State of Washington:*

GENTLEMEN — Herewith find my annual report, as the first state geologist of the State of Washington.

In submitting this report for your consideration, and possibly for dissemination throughout the state, I beg leave first to call your attention to the following facts:

By act of the legislature, the first to convene in this state, the office of which I have the honor to be the possessor, was created in March, 1890, and my appointment as state geologist and confirmation by the senate followed shortly thereafter. You will readily see the length of time that has been at my disposal for the performance of duties incumbent upon me, and which I soon found were multifarious in character. Yet during the brief period encompassing the first year of my incumbency I may say, and with feelings of personal gratification I feel you will deem pardonable, that much has been accomplished through the medium of this office and its coincidental factors toward the development and upbuilding of what I hope to demonstrate to you further on is one of our new state's greatest resources — her mineral wealth.

Very soon after perfecting those necessary preliminaries to legally taking up my work as your state geologist, I secured quarters as nearly suitable for the necessary requirements of the work as the limited funds placed at the disposal of the mineralogical department of the state would admit. These quarters I located in the sixth floor of what is known as the Barlow-Catlin, or Washington block, in the city of Tacoma, Pierce county. I forthwith prepared for business, fitting up what is now known throughout the mineral belt as the state laboratory, to the best of my ability.

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I speedily found my field of labor to be an extensive one, it becoming apparent that I must needs, to revive a lapsing interest in our mines and in mining development generally, visit all sections where mineral was known to be existent, and many in which recent discoveries had been made. Also to others in which prospectors believed it to exist and desired the advice and direction of myself, as state geologist, regarding what course to pursue in the premises.

During the past year, or rather that part of it intervening between the date of my formal taking of office and the present time, I have visited, inspected, and now report upon every mining district, every mine of promise or prospective worth, every industrial and commercial enterprise born of the mineral development of the country, and all geological formations indicative of the existence of merchantable metal in Washington, as far as known.

DUTIES OF GEOLOGIST.

My duties have not been performed without let or hindrance, either from the state government itself or private corporations and individuals. As regards the former I have only to say that so niggardly was the appropriation granted for the carrying on of a work you will see is gigantic in its proportions and of incalculable importance and value, that I have found it absolutely impossible to do it the justice I hope to convince you it richly deserves. The reticence to give information, the reluctance to admit of inspection of properties, the general desire to hold within themselves their gains, their losses, the present and prospective status of their possessions upon the part of the latter, I look upon as pardonable, because of the comparative recent establishment of a state mineralogical department.

Consider the fact that the mineral bearing area of Washington is second to none in size found elsewhere in the Union. Consider the fact that until the state decided to itself father and foster the development of this area, mines and mining in Washington were, if I might use the expression, a dead letter. Consider the fact that transportation, in the main, to and from these mines must be made in the costliest if most primitive way. Consider the cost of maintenance of a fully equipped laboratory, with its innumerable

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and expensive accessories; and lastly the incident expenses incumbent on an official occupying my position, and I think that when you compare all with what was deemed sufficient to meet all, you will agree with me that the appropriation made for this department of our state government by our last legislature was nothing more or less than ridiculously small.

But despite these lets and hindrances, the many disagreeable features incident to the first establishment of a mineralogical department in the state, and the initial incumbency of a state geologist, I feel gratified, even highly encouraged, over the progress that has been made. For as complete information concerning this latter that the limited time at my disposal has permitted me to compile, I respectfully submit the following.

HISTORICAL.

As romantic and as deeply interesting as the discovery of that precious metal in California, "the new El Dorado," away back in the days of '49, is the story of the discovery of gold in what is now the State of Washington; that event which first heralded the future greatness of the young empire, which first gave sustenance to her in her struggle for the supremacy nature had decreed she should attain and which it must be conceded proved, so to speak, the foundation stone upon which our great state has been builded. In my opinion no chapter in the absorbingly interesting history of this state is of such entrancing interest as is the story of the finding of the treasure trove of nature, from time immemorial heretofore, hidden beneath her soil.

All early settlers in the Pacific Northwest will easily recall that famous exodus of miners from all over the Pacific coast to that newest "El Dorado" of the time, the Frazier river in British Columbia; the hegira to what was then an unknown realm, being caused by stories of fabulously wealthy mineral deposits being ext istent along that great water highway. It is a popular fallacy tha the "Frazier river excitement," as it was then called, preceded that incident to the discovery of gold in Washington. To this state is due the distinction of being the first division of the Union in which gold was discovered north of California on the Pacific coast.

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It was early in 1858 that a dispute arose between the United States government and that of Great Britain over a determination of the boundary line separating the British possessions on this continent from those of our government. In amicably arranging this difficulty a scheme was perfected by which a commission was to be sent out to definitely establish such boundary lines. All the vast area now known as British Columia, Idaho and Washington was then looked upon as we look upon the depths of Africa — an unknown wilderness, except to the hardy trappers and hunters of the Hudson Bay Company, a handful of soldiers of Uncle Sam and the aborigine who called it all his own.

This boundary commission reached a point on what is now known as the Similkameen river, just this side of the established boundary line, in the Okanogan county we know to-day, early in 1859. Its members were men of iron nerve, for they had braved the dangers and trials of an almost impenetrable wilderness. They were bound south and totally ignorant of the character of the territory they must needs traverse, determined beside the beautiful and clear Similkameen to camp and recuperate preparatory to the commencement of their long journey to the southward.

This determination upon the part of these men proved the greatest boon Washington ever has received and, I opine, ever will receive at the hands of mankind, for they had been in camp scarce a fortnight when they were electrified by the discovery of golden metal in abundance, made by one of their number, who, noting the sparkle in the gravel lining the banks of the stream, became speedily convinced by investigations he made that gold lay along its shores in abundance.

Of course, as is always the case, the news spread like wildfire. Nobody could tell just how, from those hidden wilds, the news went forth that gold had been found, but soon the hardy miner of the time made his appearance.

Next he came with his "pard." Then parties of six and seven, then scores, then hundreds of gold seekers flocked to the banks of the Similkameen. Old Okanogan City was the Embarcadero for the new found placers, and like a mushroom in its natural soil here sprang up in a week a flourishing camp, which, within the first month of its existence, numbered nearly three thousand souls.

Not content with what in these days would have satiated the appetite for wealth of the miner, those hardy fellows feasted off

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the richest of the placers of the Similkameen until news came that a venturesome party in search of still richer diggings had found them in the far off Cariboo and Frazier River countries, in the realm of Great Britain. Following the instinct of his nature, nearly every man in the placers of the Similkameen packed up his outfit and rushed for the latest craze. That journey over mountain and river, valley and plain would appall the miner of to-day. But it did not those pioneers in the mineral development of the great Northwest. They laughingly braved its dangers, footed it or rode cayuses across either the state or the boundary line and penetrated by hundreds the mineral belts of the Frazier river and the Cariboo. Miners from as far south as California flocked northward to the same fields and the *entrepot* to them for these was Whatcom, pioneer settlement of Bellingham bay and a town that in the fall of 1859 is said to have been the place of residence of no less than twenty thousand souls. The Similkameen placers were left practically deserted. Beds of golden gravel from which untold thousands have been delved were left for the bubbling waters to ripple over. Okanogan, the busy, bustling, noisy mining camp of scarce three months' existence lapsed into inocuous desuetude, nature held again full sway, and as far as that busy hum incident to the presence of man was concerned, silence reigned well nigh supreme.

I have not to deal with either the Frazier river or the Cariboo excitements. It was the story, as far as they were concerned, of the Similkameen told over again. The migratory prospector, to whom always green were the hills afar off, tired of the golden treasures of these districts, and when winter approached, started for the south and more congenial climes. His course led him back whence he came—to Washington. He and his "pard," his friend and his friend's "pard," and others of his ilk by hundreds began a systematic search for wealth here. Many returned to the deserted placers of the Similkameen, others worked their way to the southward, penetrating even as far into the then trackless wilderness as the Peschastin and Cle-Elum country. There can be no doubt but that the whole of the vast area encompassing Okanogan, Stevens, Douglas, Kittitas and even Yakima counties was looked over by those roving gold hunters some time antecedent to dates secured by me when discoveries of the precious metals were first made. It is a well known fact that the first placer discovery west of the Cascade mountains was made toward the head waters

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of the Skagit river, in the county of that name, on a stream known as Ruby creek. On a recent visit to that locality I was informed by several early settlers that gold there was first found about twelve years ago. I feel therefore justified in chronicling the first discovery of gold west of the Cascade mountains to have been made on Ruby creek as recently as 1878.

South of what is now popularly designated the Okanogan country the first discovery of gold, as nearly as I can ascertain was made in what is known as the Swauk district. This discovery was made in the spring of 1874 by Ben Goodwin, an old time California miner, and a prospector who in search of hidden treasure had traversed the whole of Oregon and Idaho and then came into Washington and what is now Kittitas county. Reaching the Swauk, I am told, Goodwin lost his bearings; and camping, proceeded to look about him. As a result of this the prospector found himself the discoverer of what to-day are the richest placer mines of Washington. Of fabulous richness were those placers and as an evidence of their extent, I may say to this day they are being worked and with rich results. Nuggets valued at as high as $400 have as recently as the past season been extracted from these placers. And to old Ben Goodwin must be given the credit for having first found the state's richest seat of surface deposits of gold.

It was nearly three years after the discovery of the Swauk placers that C. P. Culver, a pioneer prospector, en route to the Columbia river and the south, found paying placer diggings on the banks of the Peschastin creek, a lively stream emptying itself into the Wenatchie river, which in turn terminates with a jointure with the Columbia river. This creek is in what is now also Kittitas county. Like the Swauk, the Peschastin placers proved fabulously rich, and were worked by hundreds of miners, thousands of dollars being extracted from them. Like the Swauk deposits, they seem to be inexhaustible, as at this writing they are being worked and with splendid returns by many miners.

With the discovery of the Peschastin placers the early history of this character of gold discovery in this state must be brought to a close, except as regards the richest placer diggings ever found in Northeastern Washington. I refer to the famous diggings on O'Sullivan creek, a small stream, but in winter a roaring torrent, in what is now Stevens county. From the most authentic information obtainable I believe these placers to have been first discovered along

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about 1865. Their discovery created the wildest excitement, miners flocking to the creek from all the then known mineral deposits of the state. Hundreds of thousands of dollars were extracted from those diggings, and as illustrative of the general character of Washington placers, let me add that those of O'Sullivan creek are still being worked and with profit by many men. I ascribe the inexhaustible character of our placers to the fact that our winter freshets annually recuperate washed out deposits with fresh quantities of paying gravel from places yet unknown to us.

The more recent discoveries of placer diggings date from the year 1881, when the Cle-Elum placers were found. The Cle-Elum river is a comparatively small stream, having its source in the Cascade mountains in Kittitas county, and emptying into the Yakima river near the prosperous little town of Cle-Elum. There was a rush of miners to the new found fields. There is no possible method by which the output of the Cle-Elum placers can be even approximated with anything like accuracy. I know the fact to be that the Cle-Elum placers are still being worked by a number of miners and with substantial results.

In 1885 George Runnels, who might aptly be termed the father of mineral discoveries in this state, penetrated that part of the state known now as Okanogan county, and prospected the different streams there in search of mineral. Mr. Runnels went alone into that domain, and after untold hardships, succeeded in ascertaining that rich placers existed at intervals along the banks of these streams. Possessed of other information concerning the country, Mr. Runnels then returned to the settlements. His report of the wealth of the Okanogan placers created great excitement, and early in 1886 a large party of miners penetrated that section. Mr. Runnels, they speedily found, had not exaggerated the situation, for the placers proved immensely rich in a coarse gold of great brilliancy and purity. These Okanogan placers have been worked continuously since they were discovered and are still said to be profitable.

To the discovery of the above placers was directly due the incursion into the country along the Okanogan river by the miners. Reports were brought to the camp that gold in large quantities had been found along the Okanogan, clear to its jointure with the Columbia. As a result a hegira to the new placers was quickly in order, and soon the noise of gold pan, rocker and "long Tom"

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could be heard all along the stream. The fabulously rich Cassimer bar at the mouth of the Okanogan yielded great wealth as a reward for the efforts of the miners, and will probably pass into history as one of the wealthiest seats of placer mining ever discovered in the North. Mr. Runnels knew this bar well, having worked upon it with handsome results as far back as 1860.

In concluding this chapter of both the early and recent history of placer mining in our state, I will say that I believe this character of mining yet in its infancy, despite the fact that it has been practiced, and continuously too, for over a quarter of a century. I base this opinion upon my firm belief that unearthed surface deposits of gold will in the future be found in abundance. They must exist, for are not our worked out placers rejuvenated year by year with fresh and rich gravel deposits, washed down from points above them by the annually recurring freshets? Why then is it not reasonable to believe that placers as extensive and as rich as those exist, whence come those annual deposits left upon our placers of to-day by the winter swollen streams beside which they are found?

GOLD BEARING QUARTZ.

To the story of the discovery and development of the mineral bearing quartz of Washington, just as much interest attaches as to that of the discovery of placer gold as chronicled above. Undoubtedly this former class of mineral had equally as much to do with the early development of the state as the placer mines, and is now an admitted leading element in building up and making the state's manifold resources and opportunities public.

Among early pioneers in the gold hunting army that invaded Washington back in the sixties, was Hon. Hiram F. Smith, present representative in the legislature for Okanogan county. To Mr. Smith and a little band of prospectors is due the credit of having discovered the first gold bearing rock found in Washington. It was on the nation's natal day, July 4, 1871, that Mr. Smith and party camped at the base of Mt. Chapaka, a bold peak rising from an undulating surrounding country. The members of the party found themselves in the heart of the home of Chief

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Moses and his warriors, in fact encamped at the very foot of the shrine at which those dusky savages worshipped their idol the sun. They were on the government grant to Moses and his band, designated the "Moses Reservation," now forming the major portion of the domain embraced within the boundaries of Okanogan county. But a brief period elapsed before numberless prominent ledges of gold and silver bearing ores were discovered, and some of these selfsame discoveries have been developed into the most promising mining properties known to the state to-day. When the story of these discoveries spread abroad, hundreds of miners went to Mt. Chapaka. A district was formally organized, and soon Chapaka City, headquarters for the district, blossomed forth a full fledged prosperous and lively mining camp. Mr. Smith, head and front of all organized effort, started a miners' union, was elected its first president, and then set about completing a thorough organization of both camp and district. Both, however, were destined to be short lived. Hardly had the work of developing their new found treasures been commenced, when one day the inhabitants of Chapaka City were surprised to find as their uninvited guests a company of soldiers of the United States army. These soldiers were from the military post at the agency of the reservation, and their commanding officer's orders were to remove, bag and baggage, every miner at Chapaka off Chief Moses' domain. And they did it, too. Soon not a vestige of little Chapaka City remained, save a few crumbling lean-tos, huts and cabins. To this fact is ascribable the reason why, when found as far back as 1871, these valuable mines remained practically unheard of until as recently as the last four years. The Moses reservation was not restored to the public domain until 1886, and prior to that time white prospectors and others were rigorously excluded from its territory.

QUARTZ IN THE PESCHASTIN.

The next discovery of mineral bearing ore must be placed to the credit of Mr. C. P. Culver. This event occurred in 1878, a little less than a year after the same gentleman discovered the rich placers on the Peschastin river, as detailed in my chapter on the

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placer mining history of the state. It was on this same Peschastin that Mr. Culver made his ore discovery, and interest attaches greatly to this discovery, because incidental to it was the erection of the first stamp mill ever operated in the then Territory of Washington. Mr. E. W. Lockwood, now an honored resident of Conconully, in Okanogan county, erected and operated this mill, and began taking out bullion from the second ore deposits known to Washington.

CLE-ELUM ORE BEDS.

In the year 1881 two prospectors, Messrs. Hawkins and Splaun, in quest of ore deposits, started from the Peschastin diggings in a northwesterly direction, along the ridge of a precipitous spur of the Cascade mountains. After a tedious journey of about fifteen miles the two noted formations favorable always to the presence of ore. They began prospecting for mineral, and as a result of indefatigable investigation, the third mineral ore discovery made in Washington was put on record. The find was located in a mineral domain now known as the Cle-Elum mining district, in Kittitas county. The discovery created quite an excitement, and was the precursor of the development Cle-Elum mining district has undergone since it was made.

In 1883 the first gold and silver bearing quartz was discovered in the Colville district, now famous as an ore producer. But not until 1885 was the district brought into prominence. In that year the now celebrated Old Dominion mine was discovered by W. H. Kearney and party. A detailed description and history of this great find I give further on in my report. The wealth and evident permanency of the Colville ore deposits led to the upbuilding of a prosperous town known to-day as Colville. This, as is invariably the case in such instances, became and continues to be headquarters and a radiating point for all operations conducted in mining sections contiguous to the Colville.

News of the finding of rich mineral deposits on the Moses reservation, and also of like discoveries in the Colville district, had spread far and wide by the time the little settlement of Colville had taken on the habilaments of a town. Then, prospectors

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braving the dangers always to be encountered had gone into the Moses reservation, traversing all the distance about the great Colville reservation to do so, and had commenced returning with stories of the fabulous wealth of the ore beds there. This news had the effect of bringing to Colville hundreds of miners from Colorado, Nevada, California, Montana and Idaho. Many of these men, not so remote from civilization as the residents of Colville, had heard rumors of the coming restoration to the public domain of the Moses reservation, and this fact undoubtedly caused them to flock into Colville in anticipation of this event, which occurred finally on that eventful day, May 5th, 1886. There was an incontinental rush for the new gold fields. Salmon river served to be one of their objective points. As a result of the rush there and efforts of the prospectors, that country boomed with excitement and several properties, now famous, were discovered. It was not long before a mining district was organized, and as far as I can remember, these gentlemen perfected this organization:

J. C. Boone, G. W. Forster, P. Pierce, George Runnels and John Gober. Salmon River district proved the fountain head from which sprang those resourceful districts, the Ruby, Galena, Chloride, Wannacut, Osooyos, and has recently, I am glad to state, caused a revival of the interest of '71 in Chapaka, so long immersed in oblivion.

WASHINGTON COALS.

It might be added, figuratively speaking at least, that the memory of the inhabitant of Washington in its earliest days goeth not back to the time when coal and iron were first found here. I have authentic information from no less a personage than the pioneer, Mr. J. Flett, that samples of coal and of iron ore were in the possession of factors of the Hudson Bay Company as early as 1842, and that for their camp fires the hunters, trappers and traders of this company were wont to chip off the surface croppings of coal and use it as a fuel. For the development given both the coal and iron resources of this state, credit is justly due Messrs. Denny and Guy, D. H. Gilman, Angus McIntosh and John Leary, of Seattle; Robert Wingate, Nelson Bennett, Frank C. Ross, A. C. Smith, D.

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T. Davies, Col. Wilkeson (after whom the famous Wilkeson coal fields take their name) and J. J. Connor, of Lyman, Skagit county.

It is with a pride born of the love we all bear to our wonderful new state that I call your attention to the equally wonderful resources she possesses in the way of fuel both hidden within her soil and exposed to her genial climate. It is to the former variety that I will refer, for it is my opinion that one of the state's richest resources is to be found in her practically limitless fields of marketable coal, as rich in variety as I have found each that I have investigated to be in value.

Extended remarks from me, however, on this subject I consider unnecessary, as you will doubtless look for exhaustive information on the same to your coal inspectors, whose duty, I understand, is to present the fullest information desired concerning the results of the duties they are commissioned to perform.

However, I feel that this report would be as incomplete, as valueless, did I not refer to and congratulate the people of this state on the fact that first in variety of her resources their chosen home ranks the leading coal producer of the coast, gives promise of becoming a veritable Pennsylvania of the West and is not yet, despite her flattering prospects and known possession of the golden key, out of her swaddling cloths.

It is even passing strange and yet, you must know, true, that young as she is, Washington is to-day looked to by the manufacturer, miner, railway magnate, steamship operator and household throughout this coast for their fuel supply.

In briefly therefore referring to our wealth of mineral fuel, let me, in as comprehensive a way as is in my power, outline at once the different qualities of coals found here thus far, and the location of the many coal fields now either producing the fuel or being rapidly developed with a view of being made to do so.

I am personally aware of the fact of the existence in Washington of anthracite, bituminous, semi-bituminous and lignite or brown coals. In so far as I have investigated these coals are all of the finest quality.

The value of coal as a fuel depends upon its density, the amount of moisture present and the amount of oxygen present, for in support of this assertion it must be known to even the school boy that the oxygen helps, and by the aid of hydrogen, produces water and waste coal. Water being an incombustible material, it absorbs

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the heat produced by the ignition of the coal. If there be too much ash, the formation of slag is nearly bound to become a probability, and the heat used in the sustenance of this slag is surely to be lost. Anthracite coal's high heating power is well known and I consider Washington's possession in that regard of incalculable value because of this fact. Bituminous coal ranks next as a high heat producer, and it is here to be found in fields of practically limitless area. This latter is deemed of especial value by the manufacturer and the general fuel consumer because of the fact that it produces great flame, and, comparatively speaking, but little smoke. It is, too, because of this fact that bituminous coal is so popular among manufacturers of gas. Washington's bituminous coals are bound to aid immensely in the future, as they have in the past, the upbuilding and development of the state in general.

It is the very best coal for the manufacturing of coke. This fact is due to that, that our bituminous coal contains a very large percentage of volatile hydro carbon, which disperses easily and rapidly when exposed to heat. The more oxygen the less carbon and combustible gasses; and the more carbon contained in the coal the harder you will find it to ignite. As I have before stated, the very finest quality of all the coals are to be found in such abundance here that a generation, in my opinion, will find their exact limits unascertained.

COAL FIELDS OF THE STATE.

Coals of the different varieties I have named are to be found in Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Cowlitz, Chehalis, Lewis, Jefferson, Clallam, Kittitas, Okanogan, Stevens, Wahkiakum, Pacific, Yakima, Klickitat, Spokane, Whitman, and Clarke counties. I report as far as is known the location of the coal area of the state, and do so to practically demonstrate its immensity. In twenty-one out of thirty-three counties, coal abounds. Here follow analyses, made by me in the state's laboratory, of both domestic, steam, gas and coking coals, including an average assay of Olympic mountain coal, taken from a vein at the headwaters of the Quillayute river. These assays as given, represent about

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every developed property in the state and also many in process of development:

Samples from—	*Moisture.*	*Volatile combustible matter.*	*Fixed carbon.*	*Ash.*	*Sulphur.*
Newcastle, King county	2.12	46.70	43.90	7.15	0.13
Black Diamond, King county	3.11	47.19	45.11	4.58	0.01
Gilman, King county	4.80	47.07	37.19	10.06	0.88
Snoqualmie coal and coke	3.90	34.28	60.53	1.10	0.19
Wilkeson, Pierce county	1.33	25.88	66.75	6.04	Trace.
Carbonado	1.80	42.27	53.11	3.82	Trace.
Upper Yakima	1.20	42.47	52.21	4.12	Trace.
Skagit River	1.19	18.80	71.66	8.35	Trace.
Roslyn	3.10	39.70	52.65	4.55	Trace.
Ellensburgh	2.00	39.10	54.40	3.40	1.10
Bellingham Bay	3.98	29.54	59.90	6.00	0.58
Cowlitz	1.16	26.12	61.90	10.69	0.13
Methow	2.50	43.71	49.27	4.26	0.26
Calispel	2.39	41.18	42.92	13.21	0.30
Olympics	5.10	39.15	47.01	7.77	0.97

COKING COALS.

I look upon the bituminous coals to be found in this state as doubly valuable because of their adaptability to be manufactured into a quality of coke excelled by none I have seen anywhere in the Union. I assert that because of this fact alone the value of our bituminous coal fields is incalculable. With our immense ore output will grow up even a greater demand for this product of bituminous coals than has yet been known of here. Coke is an absolute requirement in smelting works and innumerable other manufactories where the high heat it alone can give is an essential requisite to their successful operation.

"Coking coals," as we have come to designate them, or bituminous coals as they really are, are to be found in inexhaustible quantities in the counties of Pierce and Skagit on the western side of the Cascade mountains, and in Okanogan and Kittitas counties

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on the eastern side of that range. That our bituminous coals will make a superior quality of coke there cannot be the least doubt, as already they have been tried in the balance and not found wanting. Several coke companies in western Washington are already in operation, notable among these being two in Pierce, two in King, and one in Skagit counties. I look forward to the time when this coke manufacturing industry will attain to large proportions, for I feel certain that the quality of coke made from Washington bituminous coal is bound, when more widely known, to bring it into active and constantly increasing demand.

ASSAY OF COKE.

TWO MANUFACTORIES.

Number One.

Combustible carbon	98.63
Phosphorus	.01
Sulphur	.13
Ash	1.23
	100.

Number Two.

Combustible carbon	97.93
Sulphur	.26
Ash	1.81
Phosphorus	trace.
	100.

IRON ORES OF WASHINGTON.

It has been truthfully said that ranking with gold in the valuable metals delved from the earth is iron. Trace the various eras of our civilization from the time of the ancients to the present day, and you will find distinctive ages in which the different materials known to the architecture of these several periods have predominated over those of a previous time. We have read of the earthen age, the stone age, the timber age. To my mind it seems as if, in the natural course of events the usages of these materials, like the fashions of our time as to apparel, are returning to the ancient, and traversing again the paths denoted by their usage in bygone years.

To me it appears that we of this generation are living in an era of stone and iron as far as the architectural feature of the gen-

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eration is concerned. I say stone and iron, yet both are as distinctively separated as two materials could well be. Never in the history of the country has iron been in such demand for nearly every conceivable thing that man builds, as it has been, say during the last half century. In the United States a hundred years ago, this metal was, comparatively speaking, an unknown quantity in construction work of any kind. Now look at the demand for it for every conceivable constructive work.

Because of this demand, and it is a demand, I opine, that will last for all time, I deem the practically inexhaustible supply of the ore from which it is manufactured, that is to be found in this state, of even as great importance as is the state's wealth of the more precious metals to which in previous chapters of my report I have referred.

That Washington's supply of iron ore is as practically inexhaustible as her deposits of coal, with the aid of which the ore may be transformed to iron, may be easily demonstrated. Iron ore of the best quality is found existent on both the eastern and the western shores of Puget Sound, on both the eastern and the western sides of the Cascade mountains, a territory embracing hundreds of thousands of acres of land. It is to be found also in the eastern and southern portions of the state, and veritable mountains of this ore are known to be existent in the only recently penetrated Olympics. It has been found in King, Pierce, Thurston, Lewis, Cowlitz, Chehalis, Mason, Pacific, Kitsap, Jefferson, Clallam, Snohomish, Skagit, Whatcom, Kittitas, Okanogan, Stevens, Lincoln, Clarke, Klickitat, Whitman, and Yakima counties. So that in twenty-one out of thirty-three counties in this state, iron ore exists; and of my own personal knowledge, gained from investigation and examination, it exists in the counties I have enumerated in practically inexhaustible supply and of a most excellent quality.

The character of the iron ores in Washington, for they are open to classification, is as diversified as are the other metallic substances found in such abundance in our state. I will here enumerate the best known classes of Washington iron ores. We have deposits of the hematite (specular or red iron stone), limonite (or brown iron stone), magnetite (magnetic ore), and bog ore. These classes comprise those most useful for the purposes for which first class iron is demanded.

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The development of these great iron deposits I might say is but in its infancy. Iron ore was discovered in this state nearly half a century ago, but so isolated was the then comparatively unknown Territory of Washington, that the seat of these deposits might well have been termed a wilderness. Then again, iron ore was in no demand; the cost of mining it would prove ruinous and methods of transportation added to these facts absolutely precluded any possibility of development or even research. But as the country grew apace attention gradually became attracted to this most important factor in its upbuilding until to-day, next to gold, silver and coal, iron and stories of new found deposits of this ore will soonest catch the ear of the miner, speculator, capitalist and tradesman.

In Washington to-day there are in process of development nearly twenty promising iron properties. These are situated in King, Skagit, Kittitas, Stevens and Okanogan counties, and I am pleased to say that the development work on all of these deposits is being vigorously prosecuted. I have inspected many of these discoveries, procured samples from all visited and have ascertained that each of the classes of iron ore I named above are to be found in our own state, and that of these classes the Washington ores are of superior excellence. In King, Kittitas and Okanogan counties magnetites and hematites exist in great quantity, and the value of these varieties cannot be over estimated, as from them is made that quality of steel designated the Bessemer, and acknowledged the king of steels throughout the world. Our magnetites and hematites are peculiarly adapted to the manufacture of steel, because of the small quantity of phosphorus they carry and the high per cent. of metallic iron contained in them. I look forward with supreme confidence to the time when Washington Bessemer steel will be one of her principal manufactures, and to the time when steel works will be seen in operation throughout the great hematite and magnetite ore belt of this state. The fact that the railway development of the state has assumed really phenomenal proportions, and that iron highways are penetrating the very seat of these, and deposits of other iron ores of the classes I have mentioned, warrants the prophecy that within less than two decades the output of iron in this state will lead that of any other iron producing division of the Pacific slope.

I have inspected a number of iron properties in the counties named above, and have procured and assayed samples taken from them. As a specimen of the quality of the ore, I offer the follow-

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ing analysis made by me of a sample of the magnetite variety. This is as near an average analysis as I could procure:

ANALYSIS OF MAGNETITE, KING COUNTY.

Metallic iron	67.30
Silica	5.21
Phosphorus	.04
Sulphur	none.

It will be seen from a perusal of these analyses, that in one instance, but a trace of sulphur was obtainable, and in the other there was absolutely none.

I give below two average analyses of ore of the hematite variety:

ANALYSIS OF RED HEMATITE, WHATCOM COUNTY.

Metallic iron	59.27	Superior steel ore.
Silica	9.97	
Sulphur	trace.	
Phosphorus	trace.	

ANALYSIS BROWN HEMATITE, SKAGIT COUNTY.

Ferric oxide	55.61	Per cent. of met. iron, 52.09
Ferrous oxide	16.35	
Manganese oxide	10.95	Per cent. of met. mang., 8.48
Silica	8.30	
Lime	3.86	
Alumina	2.12	
Phosphorus	.17	
Sulphur	.75	
Combined water	1.89	
	100.00	

The following is an average analysis of bog ore, so called because of its presence in bogs or marsh lands. In this state this variety is found in the counties bordering on Puget Sound.

ANALYSIS OF BOG ORE, BELLINGHAM BAY.

Metallic iron	46.20
Silica	7.12
Phosphorus	.09
Sulphur	trace.

Ores found in Cle-Elum, Okanogan, Stevens, Yakima and Whitman counties tested by me, have shown themselves to be of an equally fine quality.

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IRON INDUSTRIES.

Always following the development and the production of ores, are industrial enterprises launched for their treatment. In Washington these industrial enterprises compare in number, capital invested and value of output with any of the other manufacturing industries of our state. As regards those following in the wake of the iron ore development, they are necessarily fewer in number, because this development is, as I have stated, yet in its infancy.

The most important of these, in fact the only one I deem it necessary to dilate upon in this report, is what is known as the Irondale works, an extensive iron ore reduction plant located in Jefferson county, on the west shoro of Puget Sound, opposite the town of Port Townsend. These works commenced operations in November, 1882, and have been operated continuously, and with success, ever since. Their output is a pig iron of great excellence, for which has grown up a demand that at times exceeds the capacity of these well managed works.

Concluding my report as regards the iron ore deposits and iron manufacturing interests of the state, I would call your attention to a peculiar fact, and that is that seldom have iron ores of any of the varieties I have named to you been found in a country possessed of such foliage and dense timber growth as is Washington, and in such close proximity to the fluxes and fuels. I reiterate, our iron ore fields are filled with an inexhaustible supply of ores of nearly all the known varieties, and I feel that others acquainted as I am with the vast extent and value of these deposits will not think my prophecy extravagant when I say that the near future will find our state wearing the sobriquet of the Pennsylvania of the West.

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INDUSTRIES INCIDENT TO MINING.

Among the state's most extensive, prosperous and growing industrial enterprises, are to be counted those which may be termed coincidental with the discovery of her wealth of the precious metals. These, I might add, are of as diversified a character as the ores which abound here. Coincidental with mining operations in Washington, I may name a score of manufacturing enterprises launched for their especial benefit, and dependent upon them for support. Three great smelters in actual operation, and one soon to be made ready for use; three stamp mills of the first class, used in crushing ores, and several other primitive yet fully equipped and useful arrastres, or Spanish mills, comprise the most important of the industrial enterprises. As far as I can ascertain, each of these is, and has been since started, in successful operation, and the management of them reports the future outlook as being of a most flattering character.

These infant industries, for all are of most recent origin, are scattered over a great area of territory: The largest smelter in the state is that located near Tacoma, in Pierce county. Next in rank in this regard is the smelter in Spokane county, near the city of Spokane Falls. Coming in third in point of proportions, is the successfully operated smelter at Colville, in Stevens county. Of stamp mills there are three of goodly size and capacity of output. One is located in Kittitas county, one in Okanogan, and one in Stevens county. The Spanish mills (arrastres) are scattered throughout the mineral belts of the state, wherever the more approved methods for the treatment of ores known to our time are not to be enjoyed.

I would fain here remark for the benefit of capitalists and investment seekers whom this report may reach, that in no other field in the country would investments be so fruitful of result as in our mineral belts, and ready and remunerative return, I feel positive, would follow such investments, were they planted in enterprises such as are essential requisites to the development, and

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maintenance as well, of an ore producing section. Sore needs of our mineral belts are additional mills, concentrators, smelters and other plant used by the reducer of ore of to-day in the transition of the deposits contained in our mineral bearing rock into gold, silver, and the other and multifarious metals of which we have demonstrated they are possessed.

Briefly as possible, I will describe the more important of the industries that have been born, so to speak, of the development of our mines, taking up the largest and most costly of these plants first, as being illustrative of the confidence comparatively new comers to our state have in these properties.

THE TACOMA SMELTING WORKS.

These extensive works are located at Swansea, an environment of the city of Tacoma, in Pierce county, and are distant from the commercial center of that city about four miles. They are most advantageously situated, being accessible on the one hand by two different lines of railway, traversing each in their route to deep water the richest of the many rich mineral belts of the Pacific Northwest; on the other, by vessels of the deepest draught that plow the seas. To more explicitly illustrate the advantageous situation of the works of the Tacoma Smelting & Refining company, I will say that they are situated on the bay shore, due north-west from Tacoma, and near Point Defiance. They are the objective point for the Union Pacific railway, now building from Portland, and are already accessible by the Northern Pacific road. They may also be reached by both steam and electric motor railways. But to my mind the desirability of their location may be best illustrated from the fact that within one hundred feet of them, the largest vessel known to the marine architecture of the present time can find berthage facilities of a character unexcelled. Their peculiar adaptability in this regard you will well understand when I say that their very situation, and the known cheapness of transportation of ores by sea, will bring to these works ores, not alone from our state, but from Alaska, the South Coast, South America,

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the far off Orient, the Antipodes, and every known country where the precious metals are to be found.

I have, in my experience as an assayer and miner, visited all the leading smelting plants in the country, and I can say this for the Pierce county smelter, that it is among the most complete, perfect and best managed establishments I have ever inspected. The methods used in sampling, reducing and otherwise treating ores are of the latest and most approved character. And that essential requisite to the success of such an enterprise, competent management, I find in this instance not wanting. The general manager of the works, Mr. W. N. Rust, has demonstrated here the ability he displayed in other parts of the country, while occupying a similar position, and his assayer, Mr. Peter Daley, is known as an accomplished chemist throughout the Pacific slope. These gentlemen have made of an enterprise, that I must confess wavered in the balance at its birth, the well founded and prosperous industry that it is to-day.

A detailed description of this fine plant I deem not amiss at this time, as nothing of an authoritative character has yet been published concerning it. Its location I have already described. The plant comprises: A substantial structure, known as the main furnace building, in size 100x60 feet; on the ground floor of this structure are situated two (2) water jacket smelting furnaces of most approved design and possessed of a capacity approximating 120 tons per diem. On the same floor, in a northern wing or "L" of the building, are located a blower house, 40x40, and a blacksmith shop, 12x20 feet.

The second floor of this building is given over to bedding floors, ore bins and furnace charging area.

On a knoll directly above and south of the main building is situated a large and substantial structure. This contains two reverbatory roasting furnaces, 17x75 feet in size. These furnaces are used mainly in the preparatory treatment of refractory ores, which are thence conveyed to the blast furnaces in the main wing I have just described. They are directly connected with this main building by tram and car.

The sampling works are located next to and to the eastward of the main building and are directly accessible by tram and car from the reverbatory furnace house, the charging floors and the blast furnace room in the main building. The ingenuity displayed in

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WORKS OF THE

TACOMA, WASH.

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the arrangement of the buildings to my mind is admirable. It will be seen by studying the accessibility of one from another, that expensive transportation of ores in process of treatment is almost entirely obviated. The sampling works are completely equipped with the latest and most approved machinery, and other mechanical appliances known to the times. In fact Mr. Daley informs me that in all his experience, he has never seen a more thoroughly fitted establishment of like character.

Both the blast and reverbatory furnaces are connected through a series of dust chambers, in size 8x10 feet, with the main stack, a substantial and symmetrical structure of brick eighty feet in height, and located to the south and directly in the rear of the main building. Contained in the building devoted to the sampling of ores are one crusher (Jackson's Denver patent), two (2) sets of rolls, also of the Jackson make and capable of crushing ore fine enough to admit of its passage through a 20-mesh sieve; one automatic split sampler, and one patent steam dryer. These sampling works are capable of demonstrating returns on at least one hundred tons of ore per diem.

A magnificent Corliss engine of 200 horse power, fed by the finest tubular boilers of most approved make, is the factor used in the operation of this almost perfect plant. The blowers used are of the Root patent, and the minor details of the establishment complete and perfect. On an average, sixty men per day are given lucrative employment at this smelter, the pay roll monthly approximating $5,500.

THE COLVILLE SMELTER.

The first of the industrial enterprises to follow the output of mineral in Eastern Washington, was a smelter for the reduction of ores of all varieties found in that section. This smelter was built in the town of Colville, in Stevens county, by Major Moore, formerly Indian agent of the Colville reservation, and present manager of the Stevens County Bank. Under the directorship of Mr. George Vivian, a mineralogist of wide experience, this smelter has been operated when practicable since its inauguration. I am informed unlimited capital is behind the enterprise, and that its founders are willing to do all in their power to forward the development and the production of the properties whose yield it was built to perfect

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and render marketable. I am informed the energy and enterprise of the owners of this smelter has not been unrewarded, and that results so far obtained have been of an eminently satisfactory character. A brief description of this pioneer of Washington's smelters I append herewith:

"The Colville," so called, is located on a bluff overlooking the town of Colville, within six hundred yards of the Spokane & Northern railroad. Construction operations on this smelter were commenced nearly four years ago. The works were in readiness to commence operations about a year later. The following are proportions of different structures, coincident to this smelter: Assay office, 25x40; ore sheds, 100x40; charcoal and coke sheds, 160x25; main building, 150x50; ore bins, 30x50; sampling rooms, 20x25; engine room, 20x30.

Under the incorporated name of the Mutual Smelting and Mining Company of Washington, this smelter has been operated. Feeders of the Colville smelter have been the following fine properties developed in the Colville district within the past few years, viz.: The Old Dominion, the famous Daisy, the Silver Crown, Bonanza, Young America, Eagle, Dandy, Capital, Summit, and other well-known Colville and Kootenai properties. To work the ores from the properties I have named it was necessary to obtain fluxes from the various iron and lime prospects in the neighborhood; coke, at a nominal expense, being brought from Pierce county.

The Colville smelter, ready for operation, stood its directorate for $40,000. The number of men employed regularly was 25, the pay-roll averaging $2,500 per month. For lime, charcoal, coke, etc., $10,000 per month were disbursed, not to speak of funds expended for ores. Shortly after the commencement of operations, the Colville smelter began shipping, on an average, three car-loads of bullion per month. This bullion is worth, on an average, $550 per ton in silver and lead; showing a monthly output of $33,000 from this comparatively small smelter alone.

SPOKANE'S SMELTER.

The enterprise of the citizens of Spokane Falls is proverbial. The interest many of the wealthy residents of that city have taken, and are taking, in the development of the mineral resources of

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Eastern Washington is most commendable, and to them is due the healthy impetus given mining matters and mines in that section, within the past half year. Their latest move in this direction has taken the shape of an organized and incorporated company of $1,000,000 capitalization, having for its object the erection, maintenance and operation of one of the finest smelting plants known to the west. Not only has actual construction work been commenced, but I am happy to say the plant at this writing is almost ready for operation. Its situation is particularly adapted for the purpose for which this great plant was built. It is located at a distance of about five (5) miles from the city, on the banks of the Spokane river, and the citizens of Spokane Falls have contributed a sufficient fund for the construction of a line of railway five miles long from a jointure with the eastern division of the Seattle, Lake Shore and Eastern railway to the site of the new smelter, thus making it accessible by direct railway communication with all that vast mineral area surrounding it, and which will be directly tributary to it.

The association of men of means which will direct the destinies of this industrial enterprise born of the mineral resources of Eastern Washington, is known as the North Pacific Reduction Company, has been regularly incorporated, and the official *personnel* of the corporation is as follows: President, Col. R. G. Ingersoll, of New York; vice president, James H. Breslin, of New York; secretary, J. N. Baker, of Spokane Falls; manager, Frederick Burbridge, of the same city.

Despite the fact that actual construction operations began on the smelting plant only late last summer, the company has completed nearly a dozen of the necessary buildings incident to the carrying out of its intentions. These comprise a furnace house, the dimensions of which are 70x90 feet; ore bins, 30x50; bedding floors, 40x40; charging floors and furnace room, 30x60; blower house, 25x30 feet; engine and boiler room, 35x35; blacksmith and carpenter shop, 25x30; general office building, 22x48. When in actual operation the smelter will use two water jackets and two reverbatory roasting furnaces, the latter being 72 feet in length and 17 feet in width. The blowers are of the Root patent. The engine is a Corliss of 200 h. p., and the two boilers of the most approved manufacture. Smoke from the reverbatory furnaces is carried through a stack 120 feet in height, while that from the

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smelting furnaces passes through the dust chambers, 8x10 feet in width and height and 140 feet long. It is then conducted through the stack, which is 140 feet in height. The sampling machinery is of the latest pattern, and the furnaces of the most desirable and approved known to the times.

The ore bins are most advantageously located, the railroad passing alongside them. The same may be said of the roasting furnaces, they being situated directly opposite the bins. Admirable judgment and forethought have been displayed in the location of the furnaces of this plant. These are situated on the hillside, thus rendering the ore bins easily accessible to them, and obviating entirely the necessity and cost of the carriage of ore to the furnaces by means of trams, cars or other devices. The situation of the furnaces with reference to the railroad is such that ore from the cars may be dumped into a chute, and by natural force of gravity conveyed directly to the sampling room.

It is the popular impression that a smelter is not a desirable acquisition to a residence locality. I must confess that my first impression gained at sight of the Spokane smelter was of a pleasing character. Its very situation, the admirable symmetry, style and neat appearance of the buildings, combined with their really romantic situation, beside the rushing Spokane river, impressed me with the actually charming ensemble made by this latest industrial enterprise launched at Spokane Falls. It is my belief that this smelter is destined to rank among the most remunerative of its kind known to the mineral regions of the West, for it is in the heart of one of the most prolific ore producing sections of the country. The commencement of operations by our smelters will, of course, inaugurate the purchase of ores from owners of them, and, in the interests of the smelters and miners, I deem it advisable to append a few remarks.

BUYING AND SELLING OF ORES.

These remarks of mine in this regard should be accepted solely as the opinions of the writer, and as methods adopted by him with success for many years in the conduct of such transactions.

Custom is often, in the transaction of business incident to mines, accepted as law. In the selling of ore it has been, and still is the

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custom, to either dispose of the material in the shape of delivering the whole output of a property for a certain period of time, or else a certain *pro rata* of such output. Sales of this nature are made, either at public auction, or through the medium of private contract. If the buyer be a smelter, it is the custom to determine the value of the ore in the sampling works connected with his plant, or else receive as proof positive of value, a certificate from a public sampling works,—something, by the way, that this state should have. In the instance I have cited, the ore should be delivered at the sampling works by the seller. Taking the ore, the buyer should estimate its value by sampling it. The custom is to first pass the ore through rock-breakers, if necessary. On ordinary grades of ores (poor ones), one-fifth is taken. Where the ores are richer, one-tenth is taken. If very rich, the whole amount is crushed and sampled. This sample is next worked down, sealed up in about four-ounce, wide mouthed bottles, usually not more than three being filled. The buyer retains one of these, the seller one, and the third is deposited in a mutually agreed upon spot for safe keeping, in case of possible dispute over the intrinsic value of the ore as sampled. It is usual to accept the smelter's assay as regards moisture, and the weight of the ore, as determined. Should buyer and seller, for instance, differ an ounce of silver in their assays of the ore, it is the usual custom for buyer and seller, thereupon, without agreement, to accept, the buyer one-half, and the seller one-half, of such difference. Payment should immediately follow a settlement between buyer and seller as to the worth of the ore, after assays have been received. New York quotations on silver and lead are taken as a standard and basis of price. All large smelting concerns daily receive such quotations from that city, and base their prices upon them. In Colorado the class of assays I have described is known as "control work." Farther west, in Nevada, Montana, Utah, etc, it is known as "referee work."

Charges for smelting vary. In different localities will be found existent different prices for this work. Where fuel and fluxes are plentiful and cheap, prices for smelting are usually and should be comparatively small. Where these essentials are a scarcity, it will be invariably found that the cost of treating ore is much higher. Dependent also on the distance a smelter has to ship its base bullion to a refinery, is the cost of treatment. Then again the class or character of ore sent for treatment has much to do with the cost.

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If the ore contain a high percentage of silica, or be a sulphide, the expense and time consumed in its treatment by the smelter warrants the imposition of a higher fee for doing the work than where the ore is an oxidized ore or carbonate ore. In addition to the first percentage of the smelter, should the ore be a zinc, heavy spar or silicious, it is the custom to charge a fixed sum per unit in excess of the smelter's percentage. For every per cent. of zinc over five in sulphuretted ores, it is customary for the smelter to charge fifty cents a unit. Over ten per cent. in ores of the oxidized variety is charged for at the rate of fifty cents per unit also. When flux is contained in the ore in the shape of lime and iron, it is customary for the smelter to lessen materially the cost of treatment. In many smelters there is a fixed schedule of prices paid for ores which are classified. If the seller's ore come up to the standard of percentage of lead set forth in this schedule, the standard price will be paid him. Should it, however, fall below, the price paid him will be decreased in proportion. For losses of silver ore sustained through treatment, the smelter is usually allowed five per cent. And where silicious or dry ores are offered, a reduction in addition to that I have just alluded to is allowable, usually aggregating not more than ten per cent. for ore of a value approximating 100 oz. per ton (2,000 lbs.), though in some smelters I have seen less than this per centum deducted; especially where ores treated were of the higher grades. I have seen as high as $25 charged for the treatment of dry or silicious ores. The usual fee, however, is from $10 to $15 per ton. When an assay shows the ore to contain an amount of lead less than ten per cent. it is not the custom of the smelter to render remuneration for that metal. Should more than one-tenth of an ounce of gold per ton be found in the ore, it is paid for usually at the rate of $20 per ounce. Of one thing prospectors and actual gold seekers may rest assured, and that is the management of every smelter now in operation in Washington will further to the extreme limit of their ability the miner in his endeavors to complete the development of the mineral resources of the state. Why should they not do so? for if the success of a smelting establishment is not dependent upon that of the man who brings it its sustenance, then upon what is it dependent?

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POINTS FOR PROSPECTORS.

That numberless miners in our gold fields would derive benefit from a few remarks on the testing and sampling of ores which may be conducted by themselves with accuracy and comparatively small expense, I believe to be true. For this reason, therefore, I incorporate the following points for prospectors in my report:

The selection of samples of ore for assay is one of the mdst important points that the prospector has to watch. No matter how large or how small the amount of ore he may be called upon to choose from, he should always try to get an average of the vein. He should use considerable judgment in taking the sample, for one part of the vein may be very rich and another of no value. Take the sample for assay as straight across the vein as possible.

When the sample is secured, pound it in an iron mortar to a powder. Then thoroughly mix the powder by stirring it with a knife or other convenient tool. Make a little cone-shaped heap, and with the knife blade divide it into quarters. The equivalent of a teaspoonful of the powder will be small enough for an assay. These are the general directions for the first step in all assays of this character. They may be modified under certain conditions, but the aim is to have the crushed sample as thoroughly homogeneous as possible in order that the part chosen for assay may truthfully represent the entire mass in respect to the quantity of mineral to be tested. The following are the assays for different metals:

GOLD AND SILVER ASSAYS.

About ten ounces of the ore should be taken and crushed to a moderate degree of fineness in an iron mortar. It is then passed through a sieve until it assumes the same degree of fineness throughout. The powder is then placed on a sheet of paper, usually about 10x12 inches. A part of the powder is then taken — generally about one-fourth of an ounce, troy weight — and put into a scorifier or a small fire clay cup that is half filled with granulated lead. The ore and lead are then covered with borax. The scorifier is put into a muffle or fire clay oven, heated to a white heat, for twenty or thirty minutes. This operation is only complete when the ore and slag have become liquid. The mass is then poured into an iron mould and allowed to cool. When cold, a button of metal

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will be found with slag adhering to it. With a hammer, remove the slag and pound the button into a cube. Now take a cupel or a little cup made of bone ash, and place in the muffle, being careful to keep a high heat; place the button in the cupel. The button will melt if the cupel is hot, and the lead will be driven off, leaving another button composed of gold and silver. This operation generally takes about thirty minutes. Pick up the button when cool and weigh it.

It is generally desired to know in what ratio to each other the gold and silver exist, or what part of the button is of gold and what part of silver. The button is now dropped into a test tube, which is a small glass tube closed at one end, and ten drops of nitric acid dropped in. Heat the tube slowly over a spirit lamp. When the silver has dissolved fill the tube with water, invert it over a small cup of fire clay made to fit the top of the test tube, called annealing cup, and in a few minutes the gold will settle at the bottom. Pour off the silver solution and dry the cup containing the gold over the spirit lamp. Weigh the button and find what ratio of weight it bears to the whole button.

If the button of gold and silver originally weighed twenty grains and the gold remaining in the test tube after the last operation, called refining, weighs two grains, the silver must have weighed eighteen grains, or gold exists in the ratio of two to twenty, or one tenth, and silver eighteen to twenty, or nine tenths, and if as shown heretofore in a ton of ore there are 233.33 ounces of gold and silver, there must be 23.33 ounces of gold and 210 ounces of silver.

The troy is the standard system of weights in use in cases of this character. Appended will be found a table showing the amount of gold and silver in ounces and decimals contained in one ton of ore of 2,000 pounds, from the weight of this same gold and silver obtained in an assay of (half an ounce) 240 grains of ore. My principle of construction of this compilation is to take the thousandth part of ten grains, which is of course equal to the hundredth part of one grain. If 240 grains of ore yield .01 grains, then 240 pounds of the same ore will yield .01 pounds, and 2,000 pounds will yield 8.333 times as much, for $\frac{2000}{240} = 8.333$. One pound avoirdupois contains 14.58333 troy ounces. One-hundredth of this, .145833, which, multiplied by 8.333, equals 1.2152729 troy ounces, which is the starting point of the table:

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COMPUTATIVE RESULTS.

If two hundred and forty grains of ore give a gold and silver button weighing thousanths of a unit of ten grains—	*One ton of ore, gold and silver, will yield, in ounces.*	*Value of silver per ton at $1.29 per ounce.*	*Value of gold per ton at $20.67 per ounce.*
.001	1.21	$1.56	$25.01
.002	2.43	3.14	50.23
.003	3.64	4.71	75.24
.004	4.86	6.28	100.46
.005	6.08	7.86	125.68
.006	7.29	9.42	150.70
.007	8.51	10.99	175.92
.008	9.72	12.57	200.93
.009	10.94	14.14	226.15
.010	12.15	15.69	251.16
.011	13.37	17.29	276.38
.012	14.58	18.85	301.39
.013	15.80	20.43	326.61
.014	17.01	21.99	351.63
.015	18.23	23.57	376.85

EXPLANATORY.—Say, for instance, .010 of gold has been found. Note that decimal in the left-hand column of the table. One ton of ore in ratio to .010 will yield the number of ounces noted in the next column to the right, directly opposite .010, and so on through the table. Computation with .010 taken as a basis may easily be made as high as circumstances may require.

COPPER ASSAY.

Weigh out one fourth ounce of powdered ore and place it in a glass flask. Add ten drops of nitric acid, five drops of sulphuric acid and three drops of hydrochloric acid. Boil the mixture over a spirit lamp until white fumes arise. Then remove, and when cool dilute with water. Filter the solution through filtering paper and add strips of metallic zinc or one or two nails. This will precipitate the metallic copper. Collect this, dry on a filter paper and weigh and proceed to find the ratio as described under the two preceding assays.

LEAD ASSAYS.

Lead assays can be made either in a muffle, pot furnace or blacksmith forge. For ordinary assays, take one part ore powdered,

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two and a half parts each of powdered carbonate of soda and borax and three nails. Mix the ore and fluxes well together on a clean piece of paper, and put into a crucible or pot. Then put in the nails and cover with salt. Place this crucible in the muffle, or forge, until its contents are melted. Pour out the molten mass into an iron mould and allow it to cool. A lead button will then be found at the bottom of the mass. Remove the slag and weigh the button. To find its ratio to the mass, proceed in the manner described under the head of gold and silver assays.

AMALGAMATION ASSAY.

Take one pound of ore and grind in a mortar to a fine powder. Add water until the mass becomes a thin pulp. Add say one or two ounces of mercury and a small lump of cyanide of potash. The whole should then be ground for two or three hours. Pour the mass into a gold pan. Wash off the dirt and ore, and the amalgam will be found at the bottom of the pan and can be collected and squeezed through a piece of linen. Heat the residue in a spoon or retort, and the small quantity of mercury left after squeezing through the bag will pass off, leaving the gold in the spoon or retort.

BLOWPIPE WORK.

The blowpipe flames are known by the names of the outer or oxidized flame, and the inner or reducing flame. The outer flame consists of inflammable vapor in a state of combustion, which is freely mixed with an excess of air. Any substance which has an affinity for oxygen meets it in the outer flame and the combustion takes place.

The inner flame consists, on the other hand, of inflammable vapor in an incomplete state of combustion from the deficient supply of air, which is unable to penetrate freely into that portion of the flame; any oxidized substance placed in this flame is deprived of its oxygen and reduced by the inflammable vapor which requires oxygen for its combustion.

In making blowpipe experiments the operator should provide himself with a piece of charcoal, which must be of a compact structure free from cracks. The surface should be cut quite clean and smooth with a knife, and a small hole not exceeding one-eighth of an inch deep cut into it. The substance to be experimented

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upon is formed into a paste with a drop of water and placed in the cavity. The inner flame of the blowpipe is directed horizontally on the paste, or as nearly parallel to the clean cut surface of the charcoal as possible.

LEAD.

Take a small quantity of powdered ore, about as much as will remain on the end of a pen-knife. Mix this with a pinch of carbonate of soda into a paste. Place in the small hole in the charcoal, turn on the flame as directed, and fuse in the inner flame. A yellow incrustation with a metallic button of lead will result.

ANTIMONY.

Proceed in the same manner as directed for the lead test, using the inner flame. A white incrustation with a brittle button of antimony will be the product.

ZINC.

Take the powdered ore and make a paste with the carbonate of soda. Fuse, cool, and moisten the incrustation with a drop of nitrate of cobalt. Heat with the blowpipe again in the outer flame. If a green color is produced, zinc is present.

COPPER.

Mix a small quantity of the ore and carbonate of soda into a paste and fuse this in the inner flame. Scrape it from the charcoal with a knife, and rub it in a mortar with a little water. Pour this into a tube, and after it has settled pour off the water. If there is copper, red scales will be seen.

ARSENIC.

Heat in the inner flame of the blowpipe any compound of arsenic and it will give off an odor of garlic.

TIN.

Mix a small quantity of the powdered ore with a small quantity of cyanide of potash and water. Fuse on the charcoal. This will reduce the substance to metallic globules of tin.

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SILVER.

Make a paste of the ore and soda. Add a small piece of metallic lead; fuse this into a button, and then cool. Make a second paste of bone ash and water mixed to an even consistency. After it has become dry, place the button of silver and lead on the bone ash and fuse. The lead will volatilize, leaving a silver globule, and if the ore contains gold a gold and silver button will result.

To separate the silver and gold, place the silver and gold bead in a glass test tube; add ten drops of nitric acid; then heat over a spirit lamp until it has dissolved. If there is gold it will appear in the form of a black powder.

MERCURY.

Put a small quantity of the ore and the same quantity of carbonate of soda into a test tube. Heat and it will yield a globule of mercury.

MAGNESIA.

Heat a small quantity of powdered ore on the charcoal and partially cool. Add a drop of nitrate of cobalt to the partly fused mass and heat again. Allow it to cool. A faint rose color indicates the presence of magnesia.

ALUMINUM.

Proceed in the same way as in testing for magnesia. A blue color indicates the presence of aluminum.

LIME.

When pulverized and placed under the flame it glows with a white heat.

BARIUM OR HEAVY SPAR.

Fuse the powdered ore on charcoal with soda. Dissolve in warm water. Add a small quantity of alcohol and set this on fire. The flame will be a yellowish green in color.

SULPHUR.

Make a paste of ore and carbonate of soda and fuse. Moisten a silver coin and place it on the mass while hot. The sulphur will stain the coin black.

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MAGNESIA.

Make a paste of ore, carbonate of soda and nitrate of soda. Fuse on the charcoal. It will leave a green mass.

BISMUTH.

Make a paste of the powdered ore and carbonate of soda. Fuse on charcoal to a reddish white color. The metal is distinguished from lead by the button being brittle. A yellow oxide on the charcoal will be left.

COLOR FLUX TESTS.

These tests must be made in a clear, open, hot fire, in order that the ore and flux in melting may have a free current of air.

Take a clean iron spoon, fill it about half full of borax, and fuse the mass. Remove the spoon from the fire and add the ore powdered. Nickel will give a red glass. Cobalt will give a blue glass. Manganese will give a purple glass.

CHROMIUM.

Take a clean iron spoon. Use equal parts of carbonate of soda and nitrate of soda. The result will be a yellow mass.

WET TESTS.

SILVER.

Dissolve a small quantity of ore in a test tube with ten or twelve drops of nitric acid. Boil until all the red fumes disappear. Cool and add ten drops of water, then filter this into a glass beaker. To this solution add a few drops of muriatic acid to precipitate a white chloride of silver. Dissolve this precipitate with ammonia, and re-precipitate again with some nitric acid. Expose this to the light and it will show a violet tint.

LEAD.

Dissolve in a test tube a pinch of the ore in dilute nitric acid. (Strong nitric acid does not dissolve lead.) Cool and add a few drops of water. Add to this a little alcohol. Precipitate the lead with sulphuric acid.

COPPER.

Dissolve a small quantity of ore in a glass test tube in ten drops of nitric acid. Cool and add fifteen drops of water and a small quantity of ammonia. A blue color will be produced.

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IRON.

Dissolve the ore the same as in the copper test. Cool and add fifteen drops of water. Then add a few drops of sulpho-cyanate of potash. The color will be red.

NICKEL.

Dissolve as much of the ore as can be got on the end of a pen-knife in ten drops of nitric and five drops of muriatic acid. Boil over a spirit lamp two or three minutes and add ten drops of water. Pour into the solution a small quantity of ferro-cyanide of potash. This will produce a whitish-green color.

COBALT.

Take as much ore as will remain on the end of a pen-knife. Put it into a glass tube. Add five drops of nitric and five drops of muriatic acid. Boil over a spirit lamp until the acid fumes have disappeared. Cool and add ten drops of water. Then add a few drops of sulpho-cyanide of potash. The color will be blue.

PLATINUM.

Take a small quantity of ore and boil with nitric and muriatic acid two hours; add a small amount of alcohol and filter the solution. Precipitate the platinum with ammonia chloride.

TELLURIUM.

Dissolve a small amount of the ore in a test tube, using the spirit lamp flame, with a few drops of sulphuric acid. A purple color shows the presence of tellurium.

MANGANESE.

Dissolve a small amount of the powdered ore in a glass test tube with two or three drops of sulphuric acid. Add one or two grains of litharge; it will change the solution to a pink color.

ASSAYER'S OUTFIT.

The outfit for making what are known as fire assays is more expensive than for the tests described in this chapter. It is not designed for the use of the prospectors upon their travels, but rather for those who can undertake the laboratory experiments

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outlined. The outfit consists of one half gallon iron mortar, one forty mesh seive, one pulp scale, one button scale, one troy scale and weights, one furnace and muffle, twenty scorifiers, one cupel mold, two pairs of tongs to handle scorifiers and cupels, two annealing cups, one pair of button pincers, one pouring mold, one spirit lamp, half dozen glass test tubes, five pounds of borax, five pounds carbonate of soda, five pounds of bone ash, five pounds of granulated lead, one pound of nitric acid, one pound of muriatic acid, one pound of suphuric acid, one pound of granulated zinc, one pound of ammonia.

PROSPECTOR'S OUTFIT.

The prospector's outfit is much less extensive and expensive. It follows:

One blow pipe, one spirit lamp, half dozen glass test tubes, four ounces of carbonate of soda, two ounces of borax, two ounce bottle of nitric acid, two ounce bottle of sulphuric acid, two ounce bottle of muriatic acid, five ounce bottle of ammonia, six ounce bottle of alcohol, one ounce of nitrate of cobalt in solution, one ounce of sulpho-cyanate of potash, half ounce yellow prussiate of potash, half ounce red prussiate of potash, one sheet filtering paper.

ORES AND MINERALS.

When pure, ores and minerals have the following percentage:

SILVER — Glance, 87.10; ruby, 59.80; brittle, 68.50; horn, 75.33; bromide, 57.40.

IRON — Magnetic oxide, 72.41; red hematite, 70; brown hematite, 59.92; carbonate, 48.25; pyrites, 60.50; arsenical, 33.57.

ZINC — Blende, 67.50; carbonate, 52; silicate, 53.80; oxide, 80.26.

CINNABAR — 82.27; mercury.

STIBNITE-ANTIMONY — 71.80.

COPPER — Native, 99; red oxide, 80.70; green carbonate, 57.30; blue carbonate, 55; glance, 79.80; pyrites, 34.60; purple copper, 55.70.

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WEIGHT AND VOLUME.

Appended is a table showing the weight of one cubic foot and the volume of one ton of a number of the more important minerals. One cubic foot of water weighs 62 pounds:

Minerals.	*Weight of cubic foot in pounds.*	*Cubic feet in one ton (2,000 lbs).*
Quartz	162	12.34
Silver glance	455	4.39
Ruby silver	362	5.52
Brittle silver	386	5.18
Horn silver	345	5.80
Antimony glance	287	6.99
Cinnabar	549	3.64
Copper pyrites	262	7.63
Gray copper	280	7.14
Galena	461	4.34
Zinc blende	249	8.03
Iron pyrites	312	6.41
Limestone	174	11.50
Clay	162	12.34

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MINING AND COMMERCIAL ENTERPRISES.

As invariably incident to the development of mines in this country as are industrial enterprises, are those of a commercial character. I have found during all my experience, and it has been extended over a period of many years, that commercial enterprises, fostered by mining development of a legitimate character, wax stronger and assume larger and influential proportions sooner than do such enterprises when dependent upon any other source of sustenance with which it has fallen to my lot to be acquainted.

Commercial enterprises coincidental with our mineral development, I am sorry to say, have not kept pace with the industrial development born of it. Where in every principal city in the state mining boards and exchanges, and bureaus of information should be established, and enjoying a healthful and useful existence, I can chronicle as being in operation but one mining board, and I congratulate its progenitors and the city of Spokane Falls, in which it is situated, upon their enterprise and their unswerving confidence in the state's mines, made manifest by its establishment.

The Spokane Mining Exchange, to which I have reference, was regularly incorporated in May, 1890, by Messrs. A. H. Paxton, D. H. Heyward, C. F. Caldwell, J. P. Rawley, R. W. Neil, Sam Gauch, N. G. Snow, E. H. Thiele, Harry C. Bell, Frank R. Wilcox, J. H. Patterson, C. F. Tascherau, Charles M. Lynch, L. K. Armstrong, F. E. Goodall and others. Business commenced about a month later and the exchange is now known throughout the mineral belt and its business accepted as a fair criterion of the state and future prospects of the miners, to further the interests of which it was established. An idea of the purposes this exchange was established to serve may be had from the following manifesto issued by General A. P. Curry, a leader in its organization, and his confreres, shortly after its incorporation. I append it and hope a perusal of it by those interested will prove of service, as I am convinced of the soundness of the doctrines set forth. I am happy to state that your action in creating the office of state geologist,

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and further, viz., as far as in your power the state's mining interests, is appreciated by the members of this exchange, who honored me on the occasion of a recent visit to the city, by their appointing me official assayer of their exchange.

MANIFESTO.

Believing the primary objects of the Spokane mining exchange to be the encouragement of mining industries, to incite an interest in mining among our citizens, and strangers visiting here, thereby encouraging the development of mining property, and increasing the sale of stocks on the floor of the exchange. To show the miners and prospectors that we, as members of the mining exchange, and citizens of Spokane Falls, appreciate the value of their work, and are ready to welcome them in our city, and to lend them a hand in developing and disposing of their claims.

To display the mining resources adjacent and tributary to our city.

To centralize the smelting and other mining industries in our midst, and to extend the mercantile trade of our city in the mining districts.

Your committee hereby declare themselves in hearty sympathy with the action of the stockholders in increasing the number of members from 100 to 500, whereby we will be able to interest in this enterprise a larger number of miners, prospectors, business men, capitalists, and property owners, and decrease the individual expense.

Your committee submit the following recommendations:

1. That miners be especially invited and encouraged to become shareholders of the exchange.

2. That a record book be opened for each mining district, which shall contain as complete a history of the district as can be compiled, also a page given to each mine or prospect, giving the date of the discovery, amount of development work done, output in tons, and in value, size of veins, owners and agents, if any, with their address, and such other information as may be desirable, thereby furnishing valuable statistics and information.

3. That a register be kept, giving the address of miners and mining men, both at home and while visiting in the city.

4. That a special effort be made in collecting a permanent exhibit second to none in the United States from all the mines,

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quarries, clay banks, etc., tributary to our city, and to that end we suggest that each miner or prospector be given a page in the district record book and be required to present the exchange a good exhibit.

5. That a collection of accurate maps of the different districts be compiled as soon as practicable and kept on file at the rooms of the exchange.

6. That a committee be appointed, whose duty it shall be to superintend the arrangement of the exhibits, maps and other property of the exchange.

7. That the rooms of the exchange be divided into four compartments, one for the use of the secretary, one for the call and business meetings, one for the display of ores, to be called the miners' room, and to be used as a reading room, where miners can meet for social and business purposes, in which shall be kept on file the daily newspapers and principal mining journals.

8. That, as the office of secretary is soon to become vacant by the resignation of the present incumbent, and as the exchange is largely dependent on his successor, great care should be exercised in the selection of said officer. His entire time and undivided attention should be devoted to the interests of the exchange.

9. That the monthly dues shall be sufficient to meet the current expenses of the exchange, and that all assessments on stock shall be used only for the purpose of increasing the mining exhibit and for permanent improvements.

Noting the success attending the establishment of the Spokane exchange, I recently began the agitation of a scheme having for its object the establishment of similar exchanges, or of mining bureaus or boards, in all the cities of the state where chambers of commerce or boards of trade were existent, and about which mineral deposits were to be found. Aside from the establishing of a mining board by the chamber of commerce of Seattle, and of which board I have the honor of being the official assayer, I cannot say that my efforts in the direction indicated have as yet been fruitful of result. But I hope during the coming year to see such mining bureaus or mining boards of exchange established at all the points I have referred to above.

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THE COMSTOCK OF WASHINGTON.

"The Comstock of Washington" is a sobriquet that delvers after the gold and other precious metals abounding in mother earth are wont to apply to our new state's very richest deposits of gold and silver. I refer to the fabulously wealthy mineral fields embraced in one of our largest counties — Okanogan, and more popularly referred to by the prospectors, mining operators and capitalists now flocking over its boundary lines as "The Okanogan Country." The history of the seat of this, nature's treasure cache of the Pacific Northwest, I think you will agree with me, is most romantic, and even akin in its recital to that weird recounter of a race for fortune given under the title of "King Solomon's Mines" by the eccentric, yet entrancing, author of that volume. A little over three (3) years ago Okanogan county, in so far as representation as an integral portion of the state's body politic was concerned, was an unknown quantity. Indeed, even in that recent period of Washington's history it might be said of the Okanogan country that it was the Africa of Washington. As a fact, it was then known popularly to our territorial pioneers, and to what men of the mines are fond to term "tenderfeet," only as "The Moses Reservation." Its fertile valleys, its grassy hills and mountain vales, were the homes of the hardy warriors of that chief famed as a fighter in the annals of Indian warfare of the country.

It was about the period I have named that incontrovertible proof of the mineral riches hidden in the Okanogan country was handed a few score of pioneer prospectors looking for wealth within its boundaries. An excitement akin to that of Leadville sprang up, and prospectors flocked into the Okanogan.

As is always the case, pioneer methods of government of the commercial relations existent among its inhabitants, gave way in a short time to the more advanced and more approved methods of our civilization as characterized in our older communities here today. Ranked among the pioneers in the ascertainment of the Okanogan's prospective wealth as a gold and silver producer were at that time many of the state's most prominent, enterprising, energetic and progressive men of the present day, and I have no fear of the belief by the general public that my statement will be

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deemed an exaggeration when I assert that to this class of Okanogan's populace of the time to which I have referred should be endowed the distinction of having placed our richest mineral producing county on the high pinnacle she has attained within such a remarkably short period of time. As representative of the class of men to which I have given reference, and to whose efforts I place the present status of Okanogan's wealth producing capabilities, I could refer to scores of our present foremost citizens. Space forbids this, however, and I offer as an example of this class, Washington's first lieutenant governor, the gentleman who, immediately upon taking the chair of an absent chief executive, demonstrated that executive ability he displayed when, individually, he designed, and afterward, with the aid of his many co-adjutors and friends, carried out the plan by which "Moses Reservation," "Africa of Washington," became Okanogan county, seat of our new state's treasure trove.

GEOGRAPHICAL SITUATION.

The rich territory, known popularly as the Okanogan country, but mayhap more properly to be designated Okanogan county, Washington, comprises all that vast area in the northwestern corner of our state, bounded on the north by the province of British Columbia, and the east by the broad Columbia river and the great Colville reservation, on the south by the rich mineral and agricultural counties of Douglas and Kittitas, and on the west by the equally famous producers of mineral and agricultural products, Whatcom, Skagit and Snohomish counties. Okanogan, old Chief Moses' reservation that was, is Washington's largest county. Its area is of greater extent than the whole state of Rhode Island—as a producer of mineral wealth it is without a peer, and I firmly believe it gives every promise of being the equal of any of the United States' most famous wealth-producing sections. Comparatively isolated from the world, its recesses of gold, silver, iron and copper deposits, accessible only by long journeys by primitive methods as yet, from terminals of the railways bearing in its direction, Okanogan county has, by sheer force of the fabulousness of its mineral wealth, forged to the front as our chief producer of the precious metals.

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Of all the mineral territory within the boundaries of our state, so far as to the present time known to man, Okanogan county's mineral belt has impressed me most favorably. I have the utmost confidence, in consequence, concerning its future. Despite the fact that I have found there great wealth, as regards the county's agricultural resources, I look to its attainment to fame and fortune, and a position as a prime factor in the development and upbuilding of the whole state at large, to its possessions, varied as valuable in the way of minerals. Give the county adequate rail communication with the outside world, and I will have no hesitancy in prophesying, even declaring, that Okanogan inside of a decade will rival any mineral producing section thus far prospected within the confines of the Union. I think its sobriquet mentioned above not up in the clouds. I look at the big child of Washington lying in the northeastern corner of her area as our state's Comstock. As diversified, as rich, are Okanogan's mineral deposits. Known as "Moses' Reservation," the present county, years ago, was found rich in the possession of gold and silver, iron, copper, and other valuable minerals; but now, as then, the county being practically inaccessible by reason of its utter isolation from the outside world, its wealth of mineral remains practically untouched, remains yet to be unearthed by man, and this, too; despite the fact that over 2,500 mining locations have been placed on record since Moses' reservation became Okanogan county.

GEOLOGICAL FORMATION.

The country rock of Okanogan county first arrested my attention as to its possibilities as a mineral producer. The rock in most parts I find to be granite, gneiss, mica and horn-blendic schists; within the northeastern part of the county, formations of granite syenite. The general aspect of the formations I have mentioned is a coarse feldspathic granite with alternating bands of horn-blendic and micacious schists. I also denoted from my investigations of the geological formation of the county, evidence corroborating me in the belief that the formation is of the primordial types, probably traceable to the Archian series.

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MINERAL DISTRICTS.

First and foremost of the mineral districts of Okanogan county ranks the Ruby, located in the southern part of the county. This district was organized in what might be called the pioneer year of investigation into our state's mineral resources, 1887, by such pioneers in the great undertaking as T. D. Fuller, R. Dilderback, John Kladisky, P. McRae, William Milliken and John Clunan. The formation of this rich district, I find to be the direct cause of the discovery on Ruby mountain, from which it takes its name, of immense deposits of gold and silver ore, by the progenitors of its organization as a mining district. Investigations conducted by me at various times since my incumbency in office, compel me to admit that Ruby district is one of the most promising we possess. I append, as a result of my frequent visits to this district, the following resume of developed mines within its boundaries, and promising prospects in process, at this writing, of such development.

Among the many mines inspected by me in my official capacity, was the

ARLINGTON MINE.

This mine is located on Ruby mountain at an altitude of 4,400 feet above sea level. The property is that of an Oregon corporation, yclept the Arlington Mining Company. It is a silver and gold property, the ore mined being known as fahlerz ore, or grey copper ore. In hue the Arlington product is of a light steel grey and carries copper, some antimony, sulphur, iron, silver and gold. Assays from the surface of the Arlington mine I found assayed as high as $1,500 to the ton (2,000 pounds).

The vein I measured six feet wide on its surface. I found an irregular pay-streak in it widening in places to three feet of the solid ore described above. The strike of the vein is north and south, and I found it almost vertical. I found the hanging wall to be composed of mica schists and the foot wall to be of granite. The Arlington is supplied with a good steam hoisting plant, works forty men, is capable of placing upon the dump thirty tons of ore per diem. A tunnel has been driven a distance of 410 feet, tapping the vein at a depth of 220 feet. A drift has been

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driven 450 feet north and 320 south on the vein. Sinking on the vein is still being carried on. Another tunnel has been projected to tap this vein at a depth of 1,000 feet. Upon the occasion of my last visit to the property, I found about 1,200 tons of ore upon the dump, and a careful survey of ore in sight allows me to approximate the same at 30,000 tons, an inside approximation. Estimating, from assays I have made from Arlington ore, its worth at $40 per ton, it will be seen that on the occasion of my last visit to the mine $1,200,000 worth was in a position to be delved from its recesses.

The company has in course of erection reduction works for the treatment of its own ore. Estimating the cost of treatment of the ore, hauling and mining expenses, as I do, at sixteen (16) dollars per ton, you will see that of their ore in sight over seven hundred thousand ($700,000) dollars are the company's as the result of its enterprise. I report the above that some idea may be had by you of the wealth of our state's mineral resources. The property is being systematically worked by experienced men, is free from water, rendered easily accessible by good wagon road from the mine to the county road, and I was surprised and pleased to see the extent of improvements in the way of buildings on the surface the operators have erected and now maintain.

THE FOURTH OF JULY MINE.

Another promising property that has several times been inspected by me is known as the "Fourth of July," I believe so called because of its discovery on the nation's natal day. The "Fourth of July" lies to the north of the Arlington mine, near the summit of Ruby mountain, at an altitude of 4,500 feet. Croppings show ten (10) feet of ore on the surface, with a pay-streak of from eighteen (18) to twenty-four (24) inches in width. The strike of the vein is north and south, dipping twenty-five (25) degrees to the eastward. The ore is a high grade quartz, carrying silver, sulphurets, sulphide of silver and gray copper. Where the ore crops a ninety (90) foot shaft has been sunk, several levels have been run, and two (2) or three (3) car loads of rich ore have been extracted and shipped to Montana for treatment, giving handsome returns. An assay from the pay-streak which I took showed eight hundred and seventy ($870) dollars in silver, with a trace of gold.

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Average assays from the vein showed the ore to be worth over one hundred ($100) dollars per ton. On the dump I measured about one hundred and fifty (150) tons good grade ore. The mine, which is the property of a Montana syndicate of capitalists, is supplied with a Ledgerwood hoisting plant of thirty (30) horse power. At present a double compartment shaft is being sunk, 4x4½ and 6x4½ feet, respectively, using 10x10 square timbers. Over a hundred (100) feet had been sunk when I last visited the property. The operations, I have ascertained, continue to be carried on with activity. The plant of the property comprises a large shaft house, blacksmith shop, ore house and boarding house. Work is pushed systematically, and I consider the Fourth of July one of the best equipped properties in the state.

THE FIRST THOUGHT MINE

Is another most promising property in Ruby district, Okanogan county. This mine is located on Ruby mountain below the Fourth of July, described above. My inspections of this mine from time to time, I here outline. The First Thought has a sixty (60) foot vein of concentrating ore with a pay-streak of about fourteen (14) inches in width. Samples taken promiscuously from the vein (but not including the pay-streak) gave lowest return eleven (11) ounces silver, highest, thirty-two (32) ounces to the ton. From the pay-streak, an assay made by me realized sixteen hundred and thirty-two and thirty-two one-hundredths ($1,632\frac{32}{100}$) ounces of silver to the ton. The First Thought ore is a quartz, carrying copper sulphide, zinc, zinc blende, galena, grey copper and brittle silver. The strike of the vein is north and south, dipping toward the east.

The property is owned by an Oregon syndicate of wealthy and progressive people, and during the past year an immense amount of development work has been prosecuted by them. Comprising this work is a main tunnel which I found driven a distance of four hundred and fifty (450) feet. Two cross-cuts across the vein from wall to wall have been driven a distance of sixty (60) feet each. A shaft sixty (60) feet in depth has been sunk on the hanging wall, a fifty (50) foot shaft on the foot wall, and a shaft one hundred and twenty (120) feet deep on the center of the vein. Thus, as you will see, over eight hundred (800) feet of development in tunnels, cross-cuts, levels and shafts have been completed by the First

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Thought people during the past year. Work has been commenced on a long tunnel destined to tap the vein at a greater depth. In my opinion, with the vein tapped at such a depth, the First Thought should be placed in such condition as to enable a daily output of a fine grade of ore approximating one hundred and fifty (150) tons. A very creditable showing regarding the output of ore has been made during the past year, and a fair approximation of the amount on the dump ready for shipment would be two hundred and fifty (50) tons. The company gives constant and lucrative employment, on an average, to twenty-five (25) men, and has equipped the mine with all necessary appurtenances in the way of buildings, etc. I believe this to be one of the coming properties of the Ruby district.

THE RUBY MINE.

Despite the popular idea that from this mine the district takes its name, such I found, upon investigation, not to be the case, although the Ruby mine, in my opinion, is one of the most promising and valuable in this wealthy district. It was christened the Ruby in honor of its product, pyrargyrite, or as it is popularly known, ruby silver. This pyrargyrite, however, is not the sole product of this property, as beautiful specimens of cuprite or red oxide of copper and specimens of native silver have been procured by me. These attracted much attention when exhibited in the rapidly growing mineral exhibit in my office, which I am completing for the state.

The Ruby is situated on Ruby mountain at an altitude of about three thousand (3,000) feet above sea level. The vein runs northwest and southeast, dipping to the southwest. An eighteen foot vein is shown on the surface, showing a white quartz ore stained with copper carbonate exhibiting some rich stringers of red oxide of copper. A shaft is already down a distance of sixty (60) feet. A cross cut has been run a distance of thirty (30) feet on the vein. A tunnel has also been driven a distance of about fifty (50) feet. At the end of the tunnel the vein shows a width of six (6) feet with a pay-streak of a little over two (2) feet. From the pay-streak an assay made by me showed three hundred and twenty dollars ($320) per ton in gold and silver. From my investigations of the formations and topography of the country,

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and taking also into consideration the showing made by the surrounding mines, I feel justified in stating that should steam hoisting works be erected and a shaft sunk, say, two hundred and fifty (250) feet on the vein, the Ruby mine could be made one of the largest ore producers in the northwest. The mine is the property of Messrs. Thomas Donan, John Clunan, William Milliken, founders of the district, and J. Bourne. It is easily accessible by wagon road built directly to the mine from the main county road.

THE WAR EAGLE MINE

Is the property of what is known as the War Eagle Mining and Milling Company. This promising property is situated west of the Ruby mine, described above, about one and one-half miles from Ruby City, headquarters of the district, and a thriving mining camp. It is accessible from the county road. Here I found an eight (8) foot vein of milling ore, carrying gold and silver. This vein runs north and south, dipping to the eastward. The ore will probably require roasting. Two main shafts have been sunk to a depth of one hundred (100) feet each, through ore. At the bottom of these shafts a two hundred (200) foot level has been driven, connecting these two shafts, and on the surface, for a distance of about fifty (50) feet, the vein has been stripped. Almost five hundred (500) tons of ore are on the dump. Assays from the dump yielded sixty-five (65) ounces of silver to the ton (2,000 pounds), with traces of gold, some iron and copper.

THE IDAHO MINE,

Adjoining the War Eagle, is the property of the Idaho Mining Company, of which George Pfunder, an old Colorado miner of wide experience, is superintendent. It is a gold, silver and lead producer of great promise. In fact, I look upon the Idaho as one of the very best properties in Ruby district, and think its development will corroborate this statement. Its owners are men of means, its superintendent a gentleman thoroughly qualified to complete the task he has undertaken. The main shaft was down a distance of fifty (50) feet on the occasion of my last visit, and a cross-cut had been completed to a distance sufficient to show fourteen (14) feet of solid mineral between walls. The work of development has been prosecuted at several other points along the

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vein, in each case most promising showings being the result. A considerable quantity of ore was on the dump when I visited the mine. Samples taken from this ore and assayed by me showed forty-two and two tenths (42.2) ounces of silver to the ton (2,000 pounds). Samples taken promiscuously from along the vein showed forty-seven (47) and fifty-four (54) ounces of silver to the ton (2,000 pounds), with a trace of gold. The property is rendered easily accessible by good wagon road from the main county road. I hope to see the development prosecuted as vigorously in the future as in the past and to the successful termination I feel its owners and indefatigable superintendent so richly deserve.

PROMISING PROSPECTS.

In Ruby district I noted a score or more of promising prospects, the result each of the indefatigable pursuit for mineral of those hardy prospectors who are doing so much toward advertising Ruby district's great promise as an ore producer to the world. All inspected by me impelled me to inform their locators, that in my opinion, the game was worth the candle. I feel that my words of good cheer to them have had a good effect, and that the work of prospecting Ruby district will be prosecuted as vigorously in the future, or even more so, than it has been in the past.

Among many of the prospects whose future looks brilliant to me, is that of George Melvin, called the "Buckeye Mine." This property has a seven (7) foot vein of quartz ore, has a tunnel in seventy (70) feet. An assay made by me showed one hundred ($100) dollars to the ton (2,000 pounds) of silver and gold. The ore is a quartz, carrying some gray copper. The Arizona, owned also by Mr. Melvin, is an extension of the Buckeye. This property has six (6) feet of ore between walls of the same character as the Buckeye. A tunnel has been driven a distance of seventy (70) feet, and a shaft has been sunk twenty-five (25) feet on the vein through ore. Assays taken from the vein by me showed from one hundred ($100) dollars to two hundred and sixty ($260) dollars to the ton (2,000 pounds), gold and silver. On the dumps of both these mines there is considerable ore.

South of the Fourth of July mine, on Ruby mountain, is the Keystone Mining Company's property. This company has been stocked by a Portland syndicate for one million ($1,000,000)

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dollars. I found an eight foot vein running north and south and dipping twenty-five (25) degrees to the east. A shaft is down one hundred and fifty (150) feet. There was considerable ore on the dump, which showed, when assayed by me, forty-five ($45) dollars per ton, silver and gold.

The Poorman is a fine prospect located between Ruby mountain and Peacock hill. It is owned by Thomas Donan, John Clunan, W. H. Singleton and ex-Senator H. W. Fairweather. The Poorman has a four (4) foot vein of quartz and galena, assaying thirty-eight (38) ounces of silver and twenty-five per cent. (.25) lead to the ton (2,000 pounds). Seventy-five (75) feet of work I found completed on this property. The northern extension of the Poorman is the Fairview, owned by the same people. Here a tunnel one hundred (100) feet long I found had tapped the ledge one hundred (100) feet below the surface. The same class of ore exists in the vein matter of the Fairview as in the Poorman mine. Assays taken from the vein showed seventy-two (72) ounces of silver and fifteen (.15) per cent. of lead per ton.

Thomas Hanscomb and others own a promising property they have named the Peacock mine. It is located on Peacock hill. Here I found a tunnel had been driven a distance of over one hundred and forty (140) feet, and it has been cross-cut between walls, showing the ledge to be over eleven (11) feet in width. The ore is a quartz and galena carrying some iron pyrites, and assays taken from the vein showed thirty-four (34) ounces of silver, sixteen (16) per cent. lead, and ten (10) per cent. iron per ton (2,000 pounds). I found considerable ore on the dump.

Another promising property I found to be what is known as the Leonora mine, the property of Col. J. T. McDonald of Ellensburgh. Here a five (5) foot vein is existent, carrying galena, brittle silver and iron pyrites. A shaft is down on the vein a distance of over sixty (60) feet through ore. Assays from the bottom of the shaft went three hundred and fifty (350) ounces silver, seventeen (17) per cent. lead, and ten and one-half (10½) per cent. iron to the ton (2,000 pounds), with some traces of sulphur and antimony. The Leonora had considerable ore on the dump when I visited the property. Col. McDonald has expended a considerable amount of money in prospecting the surface and otherwise developing the property.

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The Anaconda and Bonanza King properties are very promising prospects and already show large ledges of ore on the surface. A tunnel has been driven a distance of five hundred and fifty (550) feet, and it is expected that the ledge will be tapped soon at a depth of four hundred and fifty (450) feet.

Other promising finds inspected were the Hecla, Reindeer, Summit, Pomeroy, Missing Link, Copper Queen, Original, Modoc Chief, Bay Horse, Second Thought, Cleopatra, Wheel of Fortune, Eldorado, Black Hills and Colville. These prospects are all undergoing rapid development and all look promising.

SALMON RIVER DISTRICT.

Six (6) miles from the Ruby district, to the northward, lies another very promising mineral district, known as the Salmon River Mining District. This district was first found to contain rich mineral by Mr. George Runnels, a well known prospector. It was formally organized in May, 1886, by George W. Forster, J. C. Boone, John Gober and P. Pierce. The principal mines in this district I find lie upon the eastern and western shores of the Salmon river, after which stream the district takes its name. The district is well timbered, provided with sufficient facilities for utilizing natural motive power, and nature seems to have made of its surface a series of easily traversed highways, for without labor upon the part of man, its entire area is accessible. In my opinion, it is the most accessible of all the state's mineral districts, and its prospects as a great ore producer are of a most flattering character.

Since I became your state geologist I have paid frequent visits to this wealthy territory, and each occasion has been resultant in renewed hopes as to its future. Within its boundaries are many of the finest properties to be found in the northwest, and the energy, enterprise, and progressiveness of their owners might be emulated by other mine owners with great profit to themselves. The goaheadativeness of the Salmon river miner is proverbial in Northeastern Washington, and, undoubtedly, to this fact can be credited the wonderful development the district has undergone during the comparatively brief period of time that has elapsed since its formal organization. Prominent among the many promising properties in the district is

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THE LONE STAR MINE,

Mainly the property of Mr. Allan C. Mason, of Tacoma. This property has a steam hoisting plant. The main incline has been driven to a depth of over three hundred and fifty (350) feet in ore. Along this incline, at intervals, have been run levels, north and south, aggregating seven hundred and sixty (760) feet. On the upper workings have been completed four hundred and fifty (450) feet, all in ore. On the dump at the main workings I found about twelve hundred (1,200) tons of ore. At the upper workings the dump measured about 200 tons. It will be seen that the output has been fourteen hundred (1,400) tons of ore. The total in cross-cuts, shafts, tunnels and other development work aggregates one thousand two hundred and ten (1,210) feet. With good management, the property should be made to produce fifty (50) tons of ore per day, leaving a good reserve in sight. The mine may be reached by a good wagon road joining the main county thoroughfare, and has given employment to about twenty (20) men. Assays from this vein made by me show seventy (70) ounces silver, five-tenths ($\frac{5}{10}$) ounces gold, and thirty (30) per cent. lead, per ton (2,000 pounds). From ore on the dump I made assays showing as high as two hundred (200) ounces silver and thirty (30) per cent. lead to the ton (2,000 pounds).

THE PROMISING TOUGH NUT.

This is a mine located on the east side of Salmon river and carries a silver, galena and grey copper quartz ore. It is the property of Messrs. Walter J. Thompson, W. B. Kelley, Charles Uhlman of Tacoma, and George W. Forster of Conconully, the latter one of the organizers of this district. The vein has a north and south bearing, dipping toward the west. On the surface there is an immense blow-out of ore measuring twenty (20) feet between walls. At the apex of the vein where it crops, an inclined shaft has been sunk to a depth of fifty (50) feet, all through ore. One hundred (100) feet below this dump a tunnel has been driven a distance of two hundred and ten (210) feet, cutting the vein. Almost one hundred and seventy-five (175) tons of ore were on the dump on the occasion of my last visit to the property, and about one hundred (100) tons have been shipped to the concentrator on Salmon river. By measurement, about six thousand (6,000) tons of ore are in sight. Average ore from the mine will

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assay fifty ($50) dollars per ton (2,000 pounds), gold and silver. The mine is rendered accessible by good wagon road joining the county road. A deal of surface improvement has been made the past year, and as a result, the Tough Nut looks the prosperous property it certainly is.

THE HOME STAKE MINE

Is an extension of the Tough Nut, just described, and is in process of being patented. This property is owned by Messrs. Isaac W. Anderson, Ben. R. Everett and Otis Sprague of Tacoma, this state. Its ore is of the quartz, galena and arsenical iron variety. The vein at the croppings measures eleven (11) feet in width. Its strike is twenty-two (22) degrees north of west, dipping thirty (30) degrees south of west. A tunnel has been driven a distance of one hundred and seventy-five (175) feet. A cross-cut forty-two (42) feet and a shaft twenty-nine (29) feet in depth, complete the working development. About three hundred (300) tons of ore were on the dump when I last inspected this property. The mine is in shape to ship thirty (30) tons of ore per diem. The ore will assay about fifty ($50) dollars to the ton (2,000 pounds) silver and lead, a demonstration that the mine output per diem could be made to aggregate fifteen hundred ($1,500) dollars. On the property is an ore chute one hundred and fifty (150) feet in length connecting the workings with a good wagon road leading to the main county thoroughfare. Samples of ore from the Home Stake may be found on exhibition in the state's laboratory and have already attracted much attention from mining men.

THE SALMON RIVER GROUP

Of mines, so called because of their being the property of a single ownership, are located on the same side of Salmon river as is the Home Stake. They are silver producers, the ore being a quartz carrying galena and silver glance. These mines are the property of a syndicate composed of Henry Wellington, William Daniels, Thomas O'Neil and J. C. Boone. They are rendered easily accessible by good wagon road from the main county road. The principal producer of this group has been named the Salmon River Chief. It is located at an altitude of twenty-six hundred (2,600) feet, and it is really an extension of the promising Home Stake I have above described. The strike of the vein in this member of the group is

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north of west and dips about thirty (30) degrees south of west. The formation is mica schist. The vein carries about three (3) feet of ore (quartz carrying galena) and silver glance with a pay-streak of about twelve (12) inches. Assays of ore taken from across this vein rendered seventy-five ($75) dollars to the ton (2,000 pounds) in gold and silver, with ten (10) per cent. of lead. About fifteen tons of ore were on the dump when I last inspected the property. A tunnel has been run in on the vein a distance of forty (40) feet through ore.

Two hundred (200) feet further up the hill is located the Wellington, another member of the group. Its altitude is two thousand eight hundred (2,800) feet. This is a silver and lead property also. The strike of the vein here is north and south, and dips toward the west. The croppings on this vein at the apex showed twelve (12) inches of ore of the quartz carrying galena variety. A tunnel twenty (20) feet long has been completed on the vein, exposing four (4) feet of ore in the breast of the tunnel. A few tons of ore I found on the dump. Assays from this showed sixty ($60) dollars in gold and silver and fourteen (14) per cent. of lead.

The Knickerbocker is the third of the Salmon River group, and is the northwest extension of the Wellington. This mine shows ore of a similar character as the Wellington, and a vein of three (3) feet in width of it has been developed. Assays from this vein showed fifty (50) ounces of silver and ten (10) per cent. of lead per ton (2,000 pounds). Very little improvement had been done on the property when I last saw it, but enough to convince me, however, that it is a promising mine.

At an altitude of three thousand (3,000) feet is the Salmon Creek, the fourth member of this group. This mine's vein runs northwest and southeast, dipping westward. A cross-cut has been put in a distance of twenty (20) feet, showing five (5) feet of ore between walls. This ore is a galena, gray copper and arsenical iron. About ten (10) tons of it are on the dump. Assays of ore taken by me from this dump showed sixty-three (63) ounces of silver and twenty (20) per cent. of lead, seven (7) per cent. iron, and one and one-half (1½) per cent. copper per ton (2,000 pounds).

Northwest from this property is the Manhattan lode on the same vein as the Salmon Creek mines. This is the fifth member of this group and produces the same class of ore. A tunnel has been

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driven thirty (30) feet, developing a vein four (4) feet wide. About fifteen (15) tons of ore were on the dump when I visited the property, and assays of this dump ore rendered about forty-five ($45) dollars per ton (2,000 pounds) in gold, silver and lead.

I am very much pleased with this notable group of Salmon river mines, and I am firmly convinced that should their owners drive a tunnel commencing about two hundred (200) feet below the present workings of the Salmon River Chief, they could tap all three veins, viz.: That of the Home Stake, Wellington and Manhattan. This accomplished trio of producers should then aggregate per diem an output of not less than one hundred (100) tons of ore.

THE LADY OF THE LAKE.

This mine is located at an altitude of about two thousand four hundred and fifty (2,450) feet above the sea and is situated about three fourths (¾) of a mile from the Salmon River group of mines I have described. The ore found here is of the silver, gold and lead variety. The vein strikes north and south dipping fifty (50) degrees to the west. The croppings of this vein show eighteen (18) feet of ore. A tunnel fifty (50) feet in length has been driven through ore and a shaft has been sunk to a depth of ninety (90) feet. About the center of the claim a shaft twenty (20) feet in depth has been sunk, and at its bottom the vein cross-cut between walls twenty feet. About three hundred (300) tons of ore are on the dump. Assays have been made from ore taken from the bottom of the cross-cut, showing seventy (70) ounces of silver, and fifteen (15) per cent. of lead per ton (2,000 pounds). Ore from the croppings assayed about one hundred and twenty-five (125) ounces silver and (11) per cent. of lead. Ore from the dump assayed ninety (90) ounces of silver and ten (10) per cent. of lead. This mine, with proper development, should be able to easily produce thirty (30) tons of ore per diem.

OTHER PROMISING PROPERTIES.

Lying west of the last named property are the Diamond and Hidden Treasure claims.

On the Diamond, a tunnel has been driven twenty (20) feet and a vein of four feet of ore with an eighteen (18) inch pay-streak has been developed as the result. Assays from this property have returned sixty ($60) dollars in gold and silver.

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The Hidden Treasure lies northeast of the Diamond. There a fifty (50) foot shaft has been put down and two (2) feet of ore exposed. Assays of ore from the bottom of the shaft showed me sixty-three ($63) dollars in gold and silver.

ON MINERAL HILL.

On the west side of the Salmon river are some fine properties. One of them is known as the Laeuna mine, the property of Thomas L. Nixon and Chester F. Griesemer of Tacoma. The ore in this mine is a quartz carrying stephenite, brittle silver, tetra hedrite, grey copper and argentite (silver glance). Assays taken from the vein showed three thousand five hundred (3,500) ounces of silver to the ton (2,000 pounds). Improvements comprise two (2) shafts, one (1) fifty (50) feet in depth, the other seventy-five (75) feet, both in ore. A tunnel sixty (60) feet in length has been driven on the vein. Further down the hill another cross-cut has been started with the view of tapping the vein at a lower depth. So far a depth of seventy (70) feet has been reached. On the dump I found fifty (50) tons of high grade ore. Several carloads of this ore have been shipped to a San Francisco smelter, and after paying excessive transportation charges, a handsome profit was netted, Samples taken from the dump assayed two hundred (200) ounces of silver to the ton (2,000 pounds). A sample from the bottom of one of the shafts at a depth of fifty-five (55) feet showed eight hundred and sixty (860) ounces silver per ton (2,000 pounds). This property, fully developed, should produce fifteen (15) tons per diem of high grade ore.

THE HARDSCRABBLE MINE.

This mine has been purchased and is being rapidly developed by the Hardscrabble Mining and Milling Company. The vein crops out about fifteen (15) inches and trends toward the northwest and southeast, dipping in the latter direction thirty (30) degrees. This vein has a pay streak eleven (11) inches in width. The ore is mainly a brittle silver, assays from which gave, respectively, one hundred and seventy-eight (178) ounces, three hundred and thirty-five (335) ounces, and six hundred and fifty-eight (658) ounces, per ton (2,000 pounds). This property could be tapped by a tunnel about two hundred (200) feet below the apex of the vein, the tunnel gaining foot for foot.

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THE SUNRISE MINE.

Located at an altitude of five thousand one hundred (5,100) feet on Mineral Hill is the Sunrise mine, the property of John C. Collins and Newton Campbell. The ore here is a brittle silver, gray copper and silver glance ore. The course of the vein is northwest and southeast, dipping forty-five (45) degrees to the southeast. It is four feet between walls, with a pay streak of thirteen (13) inches. A tunnel has been driven in on the vein seventy-five (75) feet. The average assays of the ore show three hundred and seventy-nine (379) ounces of silver across the vein.

THE GROVER CLEVELAND MINE

Is located on Mineral Hill and has a four (4) foot vein of galena ore. The strike is north and south dipping forty-five (45) degrees to the east. Two shafts have been sunk, one twenty (20) feet and the other fifty (50) feet. Average assays of ore from the bottom of these shafts were fifty (50) ounces silver, sixty (60) per cent. lead and five (5) per cent. copper.

THE MOHAWK MINE.

Situated north of the Grover Cleveland, on Mineral Hill, is the Mohawk mine. The ore is a quartz carrying galena, copper, and iron sulphide. Two tunnels have been driven, one fifty (50) feet, the other one hundred and fifty (150) feet in length. Almost seventy (70) tons of ore are on the dump. The vein, at the breast of the one hundred and fifty (150) foot tunnel widens to three (3) feet, it commencing at eighteen (18) inches. The vein has been stripped in several places on the surface. Average assays taken from along the vein show sixty-five (65) ounces silver, thirteen (13) per cent. lead, eight and seven-tenths (8.7) per cent. iron, and three and twelve one-hundredths (3.12) per cent. copper per ton (2,000 pounds). This Mohawk mine properly developed, I believe, would become a great producer.

THE BRUNSWICK MINE.

Is located also on Mineral Hill. It is a bearer of ore of the galena variety, and is possessed of a twenty (20) inch vein, running north and south. A tunnel has been driven one hundred and twenty (120) feet on the vein. On the dump I saw about fifty

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(50) tons of ore. Average assays of this ore showed two hundred and twenty-five (225) ounces silver per ton (2,000 pounds), and forty-five (45) per cent. lead.

THE WASHINGTON MINE.

Among other promising properties on Mineral Hill is the Washington mine, a quartz and galena producer. Here a shaft is down a distance of forty (40) feet. The ore assays sixty (60) ounces of silver per ton with fifteen (15) per cent. lead.

Also on the hill is the Eureka mine, which has a shaft sunk sixty (60) feet. A ledge of (4) feet in width assays $42 per ton in silver.

On the hill the Minnehaha has completed a tunnel for a distance of two hundred and forty (240) feet and developed an eight (8) foot vein of good ore.

The Okanogan Belle is a galena producer, and has a tunnel driven a distance of one hundred (100) feet.

The Blue Daisy has sunk a shaft forty (40) feet. It has a large vein of ore, assays from which returned seventy (70) ounces of silver to the ton.

The Thompson mine has a shaft now down one hundred (100) feet. Ore from this property assays one hundred (100) dollars per ton.

Other locations are the Standard, Mayflower, Little Giant, Golden Brown, Buckhorn and Mammoth.

GALENA MINING DISTRICT.

Lying east of and toward the Okanogan river from the Salmon River district, is the Galena mining district. This district was organized in June, 1886, by William B. Moore, H. A. De Haas, L. Benoist and the Chilson brothers. Despite the fact that the Galena ranks, so to speak, a pioneer among the famed mineral districts of the Okanogan, but little development in the way of unearthing its hidden riches has been done. This seems strange to me, as the formation of all the area comprising this district denotes to me the presence of treasure. There are a number of good looking prospects in this district, among them the old Sonoma, Silver Belle, Nevada, Gussie Everett and Sunnyside. These properties show veins from two (2) to four (4) feet in

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width of a stromeyarite ore, a copper silver glance ore. A mill run of five hundred (500) pounds taken from the Nevada mine assayed one hundred and ninety (190) ounces silver and thirty (30) per cent. copper per ton. Some beautiful specimens of azurite and malachite of copper have been obtained from this district and are now in the state cabinet of ores. The geological formation is quartzite and lime and the ore seems to be in pockets. By a good many expert mining men, some of them of national celebrity, who have inspected Galena district, it is looked upon as a coming wonder in the mineral world, and I must confess that I think their views not unfounded.

WANNACUT LAKE DISTRICT,

So called after the beautiful lake situated within its boundaries, is one of the booming young mining districts of Northeastern Washington, and is coming to the front with a speed that in itself heralds its right to a place in the ranks of the state's leading mineral sections. The first mineral discoveries in what is now Wannacut Lake mining district, were made in 1887 on Palmer Mountain, where its richest mines are located. The first mine located in the district was the Black Bear. This mine was located in February, 1887, by Robert Dickson and John Hunter, two venturesome prospectors. The Wannacut Lake district looks to me like nature's strong box of gold, as nearly all the principal mines so far developed and in process of development are gold producers. I think this district could be appropriately designated "the gold quartz belt of Northeastern Washington."

THE BLACK BEAR MINE,

A Wannacut Lake gold producer, is located on Palmer Mountain at an altitude of two thousand five hundred (2,500) feet. This vein runs east and west and is nearly vertical. The ore is gold quartz carrying iron sulphides. The hanging wall is chlorite schists and the foot wall serpentine. A shaft has been sunk to a depth of one hundred and fifty (150) feet through ore. A vein of ore four (4) feet in width has been developed with a pay-streak averaging about three (3) feet in width. On the dump, when I visited the mine last were eight hundred (800) tons of ore that will assay seventy ($70) dollars in gold per ton. The surface equipment is first class and ten men are given constant employment.

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THE WAR EAGLE CLAIM.

Lower down the mountain, at an altitude of two thousand three hundred and twenty-five (2,325) feet above sea level, is situated the War Eagle claim. This property is owned by the company owning the Black Bear mine, the War Eagle Mining Company, with headquarters at Spokane Falls. The War Eagle has three (3) feet of quartz ore carrying sulphuretts. On this property a tunnel has been driven one hundred (100) feet on the vein, and two (2) drifts seventy (70) feet each have been driven along the vein, all in ore. On the dump I found eight hundred (800) tons of ore that will average about seventy-two dollars ($72) per ton, gold. The development of these mines is progressing vigorously and well under a skilled management, and the company expects soon to erect a stamp mill and concentrator on the works for the treatment of their own product, when employment will be given to almost fifty (50) men. The company's surface equipment is of the very best and their valuable properties are accessible by the best of wagon roads.

THE GOLDEN CROWN MINE

Is located on the wagon road east of the War Eagle Mining Company's property in the above mentioned district. This property is owned by Jones, Lee & Turner, and is a gold quartz producer. The vein comprises ten (10) feet of gold quartz. Its strike is northwest and southeast, dipping fifty (50) degrees east, more or less. A main shaft was down thirty-four (34) feet in ore when I last saw the property. On the dump I found fifty (50) tons of ore, and from it got samples that assayed one hundred and five ($105) dollars in gold per ton.

THE IVANHOE MINE.

This mine, the peer of any in the North, is located at an altitude of three thousand seven hundred (3,700) feet above sea level. It is on the northern slope of Palmer Mountain and is the property of Al. Cowherd, who discovered the mine in June, 1888, and Frederick Western. The ledge crops and has been stripped a distance of one thousand two hundred (1,200) feet, the pay-streak averaging twelve (12) inches of high grade ore. The ore is a ruby, brittle, and horn silver ore, in quartz. The strike of the vein is northwest and southeast, dipping at an angle of sixty (60) degrees west into

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the mountain. The formations are mainly diorite slates and serpentines. The mine is being worked by a large whim operated by horses. Two (2) inclines have been run down through ore sixty five (65) and eighty (80) feet, respectively. At the bottom of the latter the ore measures four and one half (4½) feet between walls, with a pay-streak of two and one half (2½) feet. At the bottom of the sixty-five (65) foot incline, the ore measures three and one-half (3½) feet, with a pay-streak of about two and one half (2½) feet. On the dump I found about two hundred and fifty (250) tons of ore that will assay over one hundred and fifty ($150) dollars per ton (2,000 pounds) silver. Shipments of this ore have been made to the Denver smelter in carload lots and returns have amounted to six hundred and thirty-six ($636) dollars per ton. A late shipment made to the Tacoma smelter netted, in carload lots, two hundred and seventy-two ($272) dollars per ton. This ore, after being mined, had to be hauled over one hundred and thirty (130) miles by wagon to the nearest railway shipping point, thence by railway, with the increased cost of transportation thereto, to the various marts for ores. This I allude to as a practical demonstration of the richness of the ore in the Ivanhoe. Some beautiful specimens of the cerargyrite and stephenite in quartz have been obtained by me from this mine, and are now in the state cabinet in my laboratory. This mine is well equipped and, I am pleased to state, is being systematically and vigorously made what it seems destined to become — one of Washington's leading mineral producers.

THE BUNKER HILL MINE,

The rival of the promising property I described above, on Palmer mountain, is located at an altitude of three thousand five hundred (3,500) feet above sea level. This vein has been worked under bond by William Nelson and Thomas Ryan, two industrious miners, who have completed considerable development work, and extracted some five tons of high grade gold ore, the Bunker Hill being distinctively a gold property. I have assayed ore from the Bunker Hill that showed returns of over one ($1.00) dollar per pound, free gold. From one five (5) pound lot of this fabulously rich ore, one hundred and forty ($140) dollars were extracted by me. Besides taking out this first-class ore, the parties have on their dump over forty tons of an ore that assays three hundred ($300) dollars in free gold to the ton. The vein crops twenty inches on

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the surface. It is a vertical vein and trends northeast and southwest. On the surface this vein has been stripped a distance of three hundred (300) feet, exposing a well defined vein of high grade ore.

Development of the property comprises two (2) tunnels, one sixty (60), the other forty (40) feet in length; a cross-cut forty (40) feet long, and a drift driven thirty (30) feet, all on the vein.

THREE EXTENSIVE PROPERTIES.

Three hundred feet above pretty Lake Wannacut, is the Triune mine, the property of Charles H. Schepster, Charles Cole, George E. Darby and W. H. Townsend, of Spokane Falls. This property was located on the thirteenth day of August, 1887. The ore is a white quartz, carrying about two (2) per cent. of iron sulphuretts. The vein crops the full length of the claim. At one place that I measured with my tape line, I found this vein to be one hundred and twenty (120) feet wide, and I am sure that it will average ninety (90) feet. On the surface I procured some rich samples of quartz showing free gold, one assay going four hundred ($400) dollars in gold per ton, taken from a sample of a fifty pound lot. This, of course, must not be accepted as an average showing of the whole vein.

Two (2) shafts have been sunk through solid ore, thirty-six (36) and nineteen (19) feet, respectively. These sinkings demonstrate at once the phenomenal proportions of the vein on the surface, and incredible as it may seem, demonstrate incontrovertibly that the ore could be quarried as is our common building stone.

Taking the length, breadth and depth of ore in sight, the result would approximate over three hundred thousand (300,000) tons. Adjoining the Triune is the Jessie, situated four hundred (400) feet further up the side of the hill. Here a three and one-half (3½) foot vein of gold milling quartz is to be found, cropping eight hundred (800) feet along the surface. Adjoining the Jessie is the Occident, another gold quartz milling proposition. The Occident vein is six (6) feet wide. A tunnel sixty-five (65) feet long traverses its length through ore. A good waterpower is in close proximity to all these properties, which are owned and operated by the four gentlemen named above. They contemplate the erection of a stamp mill, this summer, to treat their ore.

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Among other promising properties in this district that have all been more or less developed are the Spokane, Gray Eagle, Rainbow, Hidden Treasure, Great Northwest, Wide West, Lakeview, Black Tail and others of lesser note.

MOUNT CHAPAKA MINING DISTRICT

Lies north of Lake Wannacut district. It was founded as far back as 1871, and it is a coincidence that the district was born, or rather, more properly speaking, organized, on the day the bell in Liberty hall rang out the independence of the nation. Chapaka district is one of the oldest in the state and it has the distinction of being the first quartz camp ever founded in Washington. Hon. Hiram F. Smith, present legislative representative of Okanogan county, was one of its founders. A leading mine in the Chapaka district is the Julia, a property located on the east side of the Similkameen, and a silver and gold ore producer. The vein is seven (7) feet in width with no foot wall, the hanging wall being of mica schists. The ore is a quartz carrying galena. On the dump are about thirty (30) tons of ore, assays from which run from one hundred ($100) dollars to one hundred and fifty ($150) dollars per ton. A shaft has been sunk a depth of one hundred fifty (150) feet. The mine is the property of John McDonald and H. F. Smith.

THE EUREKA GROUP,

Owned by the same parties, comprises eight mines. These are the Ellamaham, with a one hundred and twenty (120) foot shaft; the San Francisco, with a one hundred and ten (110) foot shaft; the California, with a fifty (50) foot shaft; the Kelley, with a twenty (20) foot shaft; the Pontiac, with a thirty (30) foot shaft; the Utica, with a twenty (20) foot shaft; and the Cross Course, with a ten (10) foot shaft.

All of these bodies show good grades of ore and assay well. The ore is a quartz and galena, and is being vigorously mined.

THE CAABA MINE.

This concentrating proposition with the novel name is owned by the Blinn estate of Portland, Oregon, and Mr. Smith. The vein of quartz and galena runs north and south, dipping sixty (60) degrees to the west. The vein crops on the surface a width of ten

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(10) feet. An incline ninety (90) feet long has been run through solid ore. About five hundred (500) tons of ore were on the dump when I last saw the mine. Assays from this dump ore run twenty ($20) dollars silver and eight (8) per cent. lead per ton.

Lesser, but promising, new claims are the State of Maine, a patented mine; the Leviathan, a quartz and galena, assaying forty ($40) dollars in silver, two ($2) dollars in gold and ten (10) per cent. of lead per ton. The Number One mine has ten feet of quartz, two hundred (200) tons of ore on the dump and a ninety (90) foot incline. Assays from this dump go forty ($40) dollars in silver and twenty (20) per cent. lead.

THE EAGLE MINE

Is one of Chapaka's promising properties. It is the property of the Eagle Mining Company. The quartz is galena and silver. The vein at the cropping is twelve (12) feet wide, running northeast and southwest. A tunnel has been driven one hundred (100) feet tapping this ledge at a depth of three hundred (300) feet. A cross-cut between walls demonstrates the vein to be twelve (12) feet wide at that depth. On the dump I found about one hundred (100) tons of ore. Assays taken from the dump returned thirty-two (32) ounces silver and twelve (12) per cent. lead per ton. A specimen sample from the breast at the end of the tunnel went three hundred and ten (310) ounces of silver to the ton.

THE WASHINGTON MINING COMPANY

Is an Olympia organization. It comprises a quartette of promising claims, namely, the Diana, Enterprise, Olympia, and Highland. These properties all show good veins of ore, and assays have been made by me from all four veins with results of from thirty ($30) to two hundred and twenty ($220) dollars per ton. Several accessible mill sites are also the property of this company.

CHLORIDE MINING DISTRICT.

This is a new district, being but a year old. It was organized in 1889 by Robert Allison, ex-sheriff of Okanogan county, Hill Thomas, Thomas Dickson and others. The name Chloride was applied to this district on account of the peculiar ores of the same name to be found in abundance there. There are several likely

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looking properties there which lie between the Salmon River district and the Ruby district and the Methow river.

Among the different ores in the district, the following specimens have been found by me, viz., dyscrasite (antimonial silver), argentite (vitreous silver or silver glance), stromeyerite (a silver copper glance), acanthite (a silver sulphide), chalcocite (a copper glance carrying silver), proustite (a light red silver ore), tetra hedrite (grey copper ore), pyrargyrite (a ruby silver ore). These may be seen, and have already attracted much attention from mining men who have visited my office. A good many locations have been made in this Chloride district. On account of the pressure of other engagements, and the vast amount of work I found it necessary to perform when I assumed my office, my investigations in the new district were necessarily of a very limited character. Still, from those pursued by me, I am led to believe that with transportation facilities accorded it, and the value of its deposits advertised to the world, the Chloride will come to the front and be a representative seat of mining operations in the section of which it forms a part.

THE CHLORIDE MINE

Is named after the district and is one of its most prominent and promising claims. This claim has a vein four (4) feet in width of silver and copper glance ore. Assays taken from this vein run respectively two hundred and forty (240), two hundred and forty-five (245), three hundred and fifteen (315) and six hundred and fifty (650) ounces silver per ton (2,000 pounds). A tunnel has been driven on the vein a distance of one hundred (100) feet in ore. Considerable ore is on the dump. This property is that of Sheriff Robert Allison of Okanogan county. The mine is being worked under a bond, and its development is progressing steadily.

THE WINDFALL MINE

Is another of Chloride's locations of promise. This property is owned by Hill Thomas. A three (3) foot vein has been developed carrying chloride and brittle silver. A shaft on this property has been sunk a depth of sixty (60) feet through ore. There is some ore on the dump, about twenty-five (25) tons. A sample lot taken from the dump, assayed in the state laboratory by me, gave a return of three hundred and twenty-five (325) ounces silver

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per ton, two hundred and sixty-six (266) and four hundred and thirty-three (433), respectively, showing this mine to be a very valuable holding.

THE METHOW MINING DISTRICT

Lies in the western portion of Okanogan county along the Methow river, and embraces a vast domain, the formations of which lead me to believe that valuable mineral is to be found within its boundaries. The district is one of the state's largest and youngest mineral divisions, and until lately attracted but little attention from prospectors. I am glad to state that since some important developments have been resultant on prospects made in the Methow, that it is now attracting much attention, an augury of the excitement I feel will some day be witnessed within its borders. Supplied as it is by nature with that all essential requisite for carrying on mining operations, fuel, it being heavily timbered, I must say that the Methow district, from at least a surface standpoint, is a natural home of mines. Already a number of valuable placer diggings have been opened up there, and from all reports, gleaned from their owners, they are all conducting this species of mining with unqualified success. A number of prospects have been located the past season, the principal one being the Red Shirt, which is being operated with success by a Montana mining syndicate. The ore is an arseno pyrite (mispickel ore). A few tons of this character of mineral I found on the dump and secured samples. Assays taken returned thirty-five (35) ounces silver and one-half ($\frac{1}{2}$) ounce gold per ton (2,000 pounds).

OSOOYOS MINING DISTRICT.

I have now described every thing of consequence and every district in the Okanogan country save the Osooyos, one of the pioneer districts of the country, and lying in the northwestern portion of it, in the neighborhood of the Osooyos lake. The Osooyos, in point of area, compares favorably with the larger mining districts of the country, and, after lying comparatively dormant for years, seems to be attracting considerable attention. The erection of a stamp mill was commenced last summer, and in it the free gold ores to be found in the district will be treated. The fact of the establishment of this mill, I portend, will add largely to the Osooyos'

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share of attention from mining men. Judging from the principal formations found there by me, and the general lay of the ground, I think I have reason to believe that once experienced mining men enter the district and capital is infused into the development of prospects already found, then that Osooyos will certainly be heard from in no uncertain tones.

IN CONCLUSION.

Submitting you this hastily prepared but accurate resume of the mines, miners and minerals of the famed Okanogan county, I have but to say to you this in conclusion, concerning a country destined as surely in the future to bring our state prominently before the world, as our Mediterranean of the Pacific has made of our great Sound country the seat of peace, prosperity and contentment that it is.

Isolated from the world, communication with it to be had either by walking or by wagon, Okanogan county has by its merits reached the pinnacle on which it stands to-day. What the result of railway communication with that country would mean to the state cannot be estimated. I assert that the value that would accrue is practically incalculable. Were it not for the hardy gold seekers, who despite isolation from mankind, hardships of an outdoor life, the perils of the wilderness, penetrated Okanogan, staid there and developed its wealth and forced attention to it, it is my firm belief that Okanogan to-day would lie as it was when Moses' band of warriors roamed its surface — the Africa of Washington. The development of the mineral resources of the country can be credited to no railway corporation, but must be laid at the door of the men who, like our present chief executive, builded without aid, planned, framed and finished, unassisted and alone.

MINERALS OF STEVENS COUNTY.

Dame Nature was lavish in her gifts to all that vast domain we know and revere as Washington — queen of the new states added to the Union, and in herself an empire. But especially kind and generous, it would seem, she has been to that portion of Washington lying away over in her northeastern corner, in fact, this state's

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most northeasterly division—a division in itself the size of an eastern state. I refer to all that territory bounded on the north by the British possessions, known as British Columbia, on the east by the infant commonwealth of Idaho, on the south by the rapidly populating and prosperous counties of Lincoln and Spokane, and on the west by all that vast and resourceful area set apart for the use of the aborigine by an order from the Union's chief executive in 1872, and familiarly known as the Colville Indian Reservation. I refer to the county of Stevens, that division of our state now attracting so much attention from the miner, the agriculturalist and the lumberman, and that invader sure to seek resourceful fields—the builder of the iron highway.

A few years ago Stevens county was, comparatively speaking, an unknown wilderness, except to the venturesome trapper, the hardy prospector and the roving aborigine, intent not on solving the problem of the hidden resources of the section, but on slaying the deer, the antelope and other game that abounded throughout the area. I am proud to say that men of my calling first brought this resourceful section to the attention of the public, first heralded its wealth and opened the way for the influx of desirable settlers now passing over its boundary lines. But to the question of the mineral worth of the county, with which alone I shall deal.

From a mineralogical standpoint the county is divided into three different mining districts, viz.: The Colville, Chewalah and Metaline, although there are four other mining districts yet unorganized, viz.: The Little Dallas, the Clugston Creek, Bruce Creek and Summit.

GEOLOGICAL FORMATION.

The county's geological formations are granite, porphyritic granite, porphyry slate and limestone. Among the different classes of ore found in this district, and specimens of which I have secured for the state cabinet, are cerargyrite (horn silver), pyrargyrite (ruby silver), cerussite (carbonate of lead), argentite (silver glance), anglesite (sulphate of lead), minimum (oxide of lead), curprite (red oxide of copper), bornite (purple copper ore), malachite (green copper ore), azurite (blue copper ore), stephenite (brittle silver ore). I found also carbonate, oxide and sulphate of iron.

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STEVENS' MINERAL WEALTH.

You might say that Stevens county is literally besprinkled with mineral wealth, for all over its broad surface are to be found sure superstructural evidences of the hidden treasure beneath. Already some of the very richest mines in the northwest mineral belt have been developed within its boundary lines, prominently standing in the front rank among them being

THE FAMOUS OLD DOMINION MINE.

This great property was discovered in the month of April, 1885, by W. H. Kearney, the present manager of the mine. The Old Dominion, since its discovery, must be credited with an output of ore valued at, it is claimed, over $500,000.

The ore of the value stated was stoped, too, from the surface workings. There is still an immense amount of ore in sight. Over 2,500 tons have been shipped, averaging 200 ounces in silver and thirty per cent. of lead, since the opening of the mine. This at a heavy expense. The pay roll has been as high as $5,000 per month, and at the present time over $1,000 per month is disbursed for wages.

This property is located on what is known as Dominion mountain, in Colville mining district, six miles east from the town of Colville, on the Spokane & Northern railroad, near the center of Stevens county. The ore is a quartz carrying brittle and ruby silver, copper, carbonate, and sulphide and gold. The ore is in quartzite and lime. Mr. Kearney is at present engaged in running a tunnel 1,000 feet. The tunnel is at present in 925 feet, the object of driving being to strike the main ore body at the depth of 500 feet below the old workings. On the dump of the mine are about 3,000 tons of ore that will average about 30 oz. in silver per ton, besides what is in the slopes of the old workings. Assays made by me justify my statement regarding the average value of this ore. I have succeeded in procuring some exceedingly rich specimens of ore from this great mine, and have them on exhibition in my office. They are destined to form part of the state exhibit. The mine can be easily reached by a good wagon road from Colville and the railroad. Its surface equipment is of the best. I deem the Old Dominion about as thoroughly and systematically operated a mine as could be found in the northwest.

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THE GREAT DAISY FIND.

I deem next in importance as a mineral proposition to the famous mine I have taken pains to describe at length, a property situated in Summit mining district in the western part of the country, within about two miles from Daisy postoffice, on the Columbia river, 16 miles south from the Spokane and Northern railroad, and known as the Daisy mine throughout the mineral belt of Stevens county. I place my reasons for so doing on the fact that it is made easily accessible from the railroad and postoffice over a good wagon road, and the more important feature that from mine to rail communications is a down hill pull over an equally excellent thoroughfare.

The Daisy mine, as described, is a carbonate ore proposition, located at an altitude of 1,500 feet above the Columbia river, in the heart of one of the richest mineral producing district of Stevens county. It has been only within the last two years that active development work was begun on the discovery. Yet during that recent period sufficient demonstration has been given its owners, the Daisy Mining and Reduction company, that in their mine they have struck a veritable Drum Lummond, and I must confess my concurrence in their belief after a close inspection given a property I formerly would feign believe was being boomed for market purposes.

The ore in this mine at the surface has been cross-cut, showing the vein to be over 40 feet in width; and a drift 250 feet long has been run through ore. A shaft has been sunk 63 feet, showing ore all the way. The average of this ore, as shown by assays made by me, returned 30 ounces silver and 25 per cent. of iron and 18 per cent. of lead. At a distance of 63 feet below the upper workings a tunnel has been driven a distance of 165 feet to connect with the shaft to which I have alluded. From this shaft a drift has been run in on the vein a distance of 310 feet. The vein at this point averages 9 feet in width, and assays about the same as the surface ore. Fifty-five feet below the tunnel referred to, another level has been driven 86 feet, tapping the vein and running along the vein 250 feet to connect with the shaft. At a distance of 145 feet below the 55 foot level a tunnel has been driven 409 feet tapping the vein, and a drift has been driven 165 feet in ore and wants but a few feet to connect with the shaft from the apex of the vein. As will be noted I have blocked out the ore body, and my approximation of 30,000 tons of ore being in sight I feel is an inside estimate.

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Over 2,000 tons of a desirable smelting ore have been shipped from the mine to the various smelters in the west, the Tacoma Smelting and Refining Company, at this city, receiving the lion's share. I consider the Daisy a systematically worked property, and believe its thorough development due to the gentleman the company has seen fit to place in charge of it. I confess myself under obligations to this gentleman, Manager Fred W. Day, for many kind favors bestowed and attentions shown me as a state officer on the occasion of my last visit to this property.

THE SILVER CROWN MINE

Is a silver and lead proposition located in what is known as the Little Dalles district, in the northern portion of Stevens county, on the Columbia river, about five miles from Little Dalles postoffice and within 500 feet of the Spokane & Northern railroad. It is the property of the Silver Crown Mining Company, who also own the Northern Light Mine described below. The Silver Crown is being worked by a large force of miners under the direction of Mr. A. K. Kelley, an experienced miner and the general manager for the company.

I found at this mine considerable development work completed and a large amount in hand. A 60 foot shaft has been sunk. A tunnel has been driven 130 feet and cross-cuts completed aggregating 73 feet. A tunnel 10 feet driven 100 feet from a point 200 feet below the surface taps the vein.

The vein is three feet wide, of solid galena carbonate and oxide of lead, and lies in quartzite and lime. The strike of the vein is east and west, being almost vertical. On the dump I measured about 150 tons of ore. Average assays of this ore by me returned 90 ounces of silver and 40 per cent. of lead.

On the Northern Light, to which I referred above, a tunnel has been driven a distance of 70 feet and a shaft sunk 40 feet through ore of similar character. About three thousand tons of ore are in sight. A 600 foot tunnel has been commenced to tap the veins of the Silver Crown and Northern Light at a depth of 750 feet. On completion of the tunnel the company should be able to ship from 40 to 50 tons of ore per diem and measurably increase their working force.

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THE EAGLE MINE.

The property of the Eagle Mining Company, is situated in the Chewelah mining district, in the center of Stevens county, and sixty miles north of the city of Spokane Falls. The mine is within one and one-half miles of the town of Chewelah, on the Spokane & Northern railroad. The output of this mine is a smelting ore of cerussite or carbonate of lead, and anglesite or sulphate of lead, oxide of lead and galena. The vein is about four and a half feet in width, with a trend toward the northeast and southwest, dipping to the southwest. It is a contact vein in quartzite and limestone. This mine was discovered in 1885 by Wagner, Henshaw and Williams, and was sold by them to the present operators, the Eagle Mining Company. About 1,600 feet of development work has been completed, in the shape of tunnels, winzes, shafts, etc. An excellent steam hoisting plant is on the property, and a shaft is being sunk 250 feet deeper than the present workings. On an average, 25 men are employed in and about the mine. The pay roll amounts to about $2,500 per month. The company has been shipping about fifteen carloads of ore a month to smelters in Butte and Tacoma, the output averaging about ten tons per day. On the dump I measured about 200 tons of ore. Assays of the ore from this property made by me returned about 40 ounces of silver to the the ton, with 52 per cent. lead.

THE YOUNG AMERICA MINE.

This fine mine was discovered in October, 1885, and is operated by the Young America Consolidated Mining Company. It is a smelting proposition and the ore is galena. The vein is five feet wide, bearing northeast and southwest, and lying in lime. About 250 feet of development work in the way of shafts and tunnels has been completed. A shipment of a few car lots of the ore has been made to different smelters. One shipment returned 93 ounces of silver and 37 per cent. of lead. About 150 tons of ore were on the dump when I last visited the mine, and assays made by me from this ore returned 82 ounces of silver and 47 per cent. of lead per ton.

The Young America is near the Columbia river, in Colville mining district, about sixteen miles north of the town of Col-

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ville and the Spokane & Northern railroad. It is accessible by good wagon road from Colville and the railroad.

THE BONANZA MINE

Is located in the Colville district near the Young America just described. This fine property was discovered in October, 1885. It is located on Bonanza hill, and is owned and operated by Marcus Oppenheimer, C. R. Armstrong and H. Emmsler. It is an immense deposit of galena ore, and is essentially a smelting proposition in lime and slate. After an expenditure of $1,500, the owners succeeded in extracting about 2,000 tons of ore, which was shipped to a smelter and handsome returns realized therefrom. Average assays of the ore were from 50 to 65 per cent. lead per ton. My assays of ore from this mine showed 18 ounces silver and 62.50 lead per ton. Development completed comprises two cross-cuts, one of 60 the other 42 feet in length. A shaft is down 35 feet. I found the mine had several thousand tons of ore in sight. The surface improvements comprise whim works, boarding house and shaft house. A good wagon road connects the mine with the main county road.

THE EXCELSIOR MINE.

This mine was discovered in the spring of 1886, and is owned by J. H. Young & Co. It is located near the Silver Crown Mining Company's property, in the Little Dalles district, near the Spokane & Northern railroad. This is a galena ore producer. The vein, two feet in width, carries iron pyrites, runs east and west, dipping into the hill. An 80 foot tunnel has been driven into the hill, tapping the vein. About 35 tons of ore were on the dump on the occasion of my last visit to the property. Assays of this ore on the dump made by me gave the handsome returns of 118 ounces of silver, 50 per cent. lead, and 15 per cent. of iron.

THE SUMMIT MINE

Is located in Chewelah mining district. It is situated about 18 miles west of the town of Chewelah, a flourishing camp, and is directly on the line of the Spokane & Northern railroad. A good wagon road renders the mine easily accessible from both Chewelah and the railroad. J. N. Squire owns the Summit mine, which is

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one of a quartette of fine properties owned by him and designated the Squire group of mines. These I shall describe *seriatim.*

The Summit is a galena and anglesite (sulphate of lead) ore. The vein runs north and south dipping to the westward. It is three feet in width. The Summit has a shaft sunk to a depth of 300 feet, with a level extending 50 feet from the bottom of this shaft, tapping the vein. The shaft is nicely timbered, and one of the most thoroughly constructed that I have seen in that section of the mineral belt. On the dump I measured 75 tons of first class ore of the variety I mentioned above; and also 200 tons of second class ore. The former grade returned 50 ounces of silver and 45 per cent. of lead per ton. The latter, or second class, returned 15 ounces of silver and 20 per cent. lead per ton. Assays made by me in the state laboratory from samples taken from the Summit dump, gave 63 ounces of silver and 41.30 per cent. lead per ton. This was the first class ore.

The second member of the Squire group is known popularly as the Blanche lode, which is situated close to the Summit mine. The ore is a quartz and copper glance, of which there is a two foot vein. Assays taken by me have returned from 100 to 400 ounces of silver, and 8 to 10 per cent. copper per ton.

About 30 tons of ore were on the dump on the occasion of my last visit to the property. Several car loads of high grade ore have been shipped from the mine to the Denver smelters. A 50 foot incline has been driven through ore. The surface improvements are of a substantial character.

On the remaining two claims in the Squire group, comparatively little development work has been done.

BELLE OF THE MOUNTAIN.

In this same Summit district is situated the Belle of the Mountain mine, a gold producer. Here a vein three feet in width has been developed of gold quartz ore. The trend of this vein is east and west, dipping into the mountain on which the mine is located. About ten tons of ore were on the dump. A shaft 20 feet in depth has been sunk. Assays from the ore on the dump returned me $20 in free gold. This mine is the property of Mr. C. H. Bodge, who is a present directing the work of developing the property.

The Blue Belle, of which the Belle of the Mountain is an exten-

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sion, is situated directly south of the latter property, and the strike and dip of the two mines are identical.

The Blue Belle is also a gold producer, having a well defined vein of gold quartz ore three feet in width. On this property a shaft of 40 feet has been sunk through ore. About 50 tons of ore were on the dump from which I took samples promiscuously, which returned me $20 per ton in free gold. P. Kearney, D. B. Arman and J. Davis are directing its development. The prospect of a rich gold producer I think flattering for this mine. Both the Belle of the Mountain and the Blue Belle are rendered easily accessible from camp and railway through the medium of good wagon roads, and could be made to produce 15 tons of ore per diem, enough to warrant the erection of a 10-stamp mill.

THE WELLINGTON MINE,

Located in Summit district, four miles south of the famous Daisy mine, heretofore described by me, is the property of W. H. Kearney, the manager of the equally famous Old Dominion mine, of which I have also written. The Wellington is essentially a smelting proposition, the ore being a carbonate of lead and iron. A shaft has been sunk a depth of thirty feet on the vein, which is two and a half feet in width. A cross-cut has also been run, both shaft and cross-cut in ore. On the dump I measured about 25 tons of ore. From assays taken I got returns as follows: 75 ounces of silver, 20 per cent. lead and 13 per cent. iron per ton.

THE VICTORY MINE

Is a very promising youngster, located in the Summit district, being a parallel claim to the Daisy, lower down the mountain. It has a four foot vein of quartz carrying galena, iron, pyrites, etc. The development of this property has, thus far, not been of an extended character. A shaft 15 feet deep, in ore, comprises the development. On the dump I measured about 20 tons of ore. From assays taken from the dump I got as returns: 60 ounces of silver, 13 per cent. lead, 9 per cent. iron per ton (2,000 pounds). If this mine was properly developed, I am of opinion that its output per diem could easily be made 10 tons.

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THE OLD ABE MINE.

The property of Mr. J. N. Squire, a pioneer prospector of Stevens county, and owner of the Squire group of mines I have described, is situated in the Summit district, near the Columbia river and transportation by rail and water. This is a smelting proposition. Here a four foot vein of quartz carrying iron and copper has been developed. A 40 foot shaft has been sunk on the vein, traversing that distance through ore. At the bottom of this shaft, for a distance approximating 15 feet, a drift has been driven. On the dump I measured 20 tons of ore. I secured valuable samples of this ore, and at the state laboratory I assayed them. My returns were: 20 ounces of silver, 5 per cent. copper, 15 per cent. iron. With proper development this property, like the one above described, should be made to produce 10 tons of ore per diem.

THE TEMPEST MINE.

This property is another extension of the Daisy mine. The ore here is a quartz galena and arsenical iron. A vein of ore 4 feet in width has been developed. Assays taken from this vein returned from 100 to 400 ounces per ton (2,000 pounds). A shaft is already down 35 feet through solid ore. On the dump I measured about 15 tons of ore. Properly developed, the Tempest should easily produce from 5 to 10 tons of ore per day. The mine belongs to Bell & Harton of Stevens county, and I consider it among the most promising discoveries yet made in that section.

The Best Out is a newly located mine owned by Graham & McDonald of Stevens county. The ore found is of the carbonate ore, assaying 35 ounces of silver and 40 per cent. lead. The location is within half a mile of the Daisy in Summit district, and easily accessible. The vein is 4 feet in width, and the only development so far made is the sinking of a shaft 10 feet through solid ore.

The Lucky Jim is another very promising new find. This claim is located in Summit district just above the Daisy mine up the hill, and is the property of Robbins & Co. of Stevens county. The ore is a silver glance and galena, in lime. The strike of the 4 inch vein is north and south, dipping 45 degrees to the west. A shaft has reached a depth of 20 feet, showing ore all the way from the surface. On the dump I measured about 5 tons of ore, and from it procured samples which assayed the fabulous amount of 1,000 ounces of silver and 45 per cent. lead to the ton.

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THE CAPITAL MINE.

This property is situated about eight and a half miles south of the town of Chewalah, on the county road in Chewalah mining district, within easy access of both town and railroad over a good wagon road. The mine is the property of E. E. Alexander and H. P. Reeves of Stevens county. The vein here is seven feet in thickness of limonite iron or brown hematite of iron. The strike of the vein is northeast and southwest, dipping to the westward. The hanging wall is porphyry and the foot wall of lime. Development work comprises a shaft now down 20 feet through ore, and several small cross-cuts. On the dump are 30 tons of ore. Samples of this oxide of iron taken from the dump give 55 per cent. metallic iron, 6½ per cent. silica, a trace of manganese, 4 per cent. of lime, a trace of sulphur and no phosphorous. This is a most desirable ore and it will be sure to be in great demand.

THE FINLEY MINE,

A fine property, is situated eight miles northwest of the town of Chewalah, on the Spokane Falls & Northern railroad. It is the property of W. H. Fife, of Tacoma, J. M. Buckley, of Spokane Falls, and W. E. Sullivan, of Chewalah.

Here is a three feet vein of quartz carrying galena, copper and iron pyrites. The strike of the vein is northeast and southwest, dipping to the north. Developments consist of one inclined shaft sunk through ore on the vein a distance of 75 feet. On the dump I measured about 50 tons of ore. A lot of ore shipped to a Montana smelter yielded 90 ounces of silver and 20 per cent. of lead per ton.

For smelting purposes, when the new smelter at Spokane Falls commences operations, its proximity to the railroad communication and the very excellent quality of its output impels me to believe that the Capital claim will soon rank among the most prominent in Stevens county.

THE TENDERFOOT MINE.

Fifteen miles east of the flourishing town of Colville, on the Spokane Falls & Northern railroad, in the Clugston Creek district, on the south fork of Clugston Creek, is situated the Tenderfoot mine. T. D. Hayden, sheriff of Stevens county, P. D. Grace and

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M. D. Mahoney, of Kootenai, B. C., are the owners of the mine. This is a galena proposition in lime and slate contact. The strike of the vein is northeast and southwest, dipping east, and is 4 feet in width. Developments made comprise three tunnels, one 50 feet, one 90 and one 120 feet in length. At the breast of the 120 foot tunnel they have drifted on the ore vein 60 feet north and 40 feet south. A wooden ore chute 50 feet long for the conveyance of ore from the dump to the the wagon road. On the dump I measured about 100 tons of ore. From the samples picked up promiscuously and assayed by me returned 15 ounces of silver and 60 per cent of lead. The amount of ore in sight on the occasion of my last visit to the mine would approximate 1,000 tons, and the mine is capable of an output of 15 tons per diem. Several car-load lots shipped to the smelters averaged 15 ounces in silver and 60 per cent. lead per ton. On the surface considerable work in the way of substantial improvements is to be noted.

SILVER LEAD MINE.

This property, under the same ownership as the Tenderfoot mine I have just described, is located directly across a gulch intervening between it and the Tenderfoot. It is a large deposit of hematite and is practically undeveloped. A great amount of ore is in sight on the surface. About 1,000 tons of ore from this deposit have been shipped to the smelter at Colville. The lead, gold and silver in the ore has reimbursed completely the owners for the mining, transportation and the smelting of the same. The ore assayed 60 metallic iron, and is worth $10 to $15 per ton for smelting purposes, being used as a flux.

Among the other well known galena silver properties in the vicinity undergoing development are the "Dandy" and "Moonshine" and one or two others of lesser importance.

BRUCE CREEK DISTRICT.

Although termed a mining district, this district has never been formally organized. It is situated northeast of the town of Colville, in the vicinity of the Clugston Creek mining district, reference to which I have already made. Among properties I inspected in this Bruce Creek district were those of the Al Ki Mining Company, which owns the principal properties in the district. This is a

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Stevens county organization, formed in November, 1890, of which S. Douglass is president and John Kehon manager. This company owns five claims, viz.: The Silver Wave, Myrtle, Morning, Ranger and Fraction.

The Silver Wave has a 4 foot vein of galena. The Myrtle has a 3 foot vein of the same character of ore. Considerable development work has been done on all of these properties, and considerable ore lies on the dump of each of them. Assays from the Silver Wave returned 56 ounces of silver and 64 per cent. lead per ton. Assays from the Myrtle returned 17 ounces of silver, 2.50 of gold and 50 per cent. of lead per ton.

Another good property in the Bruce Creek district is the Dead Medicine mine. This property is owned by Judge George Turner of Spokane Falls, and George W. Forster also of Spokane Falls. The strike of this vein is northwest and southeast, and dips to the north. The ore is a decomposed quartz carrying galena. Development work consists of a shaft sunk to a depth of 50 feet through ore. At the bottom of this shaft the ledge matter is 6 feet wide, with a pay-streak of 24 inches of solid galena. On the dump I measured about 35 tons of ore. Assays taken from the vein showed 33 ounces of silver and 62 per cent. lead per ton. Assays from the dump showed 32 ounces of silver and 50 per cent. lead per ton.

THE METALINE DISTRICT.

Isolated from surrounding settlements, practically cut off from communication with the outside world, is a mining district, the last I shall describe in Stevens county. This is known as the Metaline district, so called from the immense amount of metal in sight, and is located in the far northeastern corner of that county. This is one of the largest and oldest mineral divisions of Stevens county, and is certainly destined to rank a leading mineral producer of the state, once transportation facilities both by rail and water are granted it. The wealth of its mineral possessions taken into consideration, I marvel that the long silence either of the United States government or our own state government have not paved the way for the gaining of the treasure trove I know to be existent in the Metaline. I prophesy that with the removal of the Little Falls, an obstruction in the Pend d'Oreille river as thoroughly shutting out communication by that water highway with the Metaline, that dis-

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trict inside of a year would be the goal of hundreds of prospectors, operators, capitalists, and investment seekers. These falls, if such they may be properly designated, could be moved for less than $5,000, and an avenue of communication with the Metaline district opened up from Lake Pend d'Oreille and the main line of the Northern Pacific railroad, thus permitting of the transportation of the mineralof this district to the various smelters scattered throughout the Pacific Northwest.

In the Metaline are immense deposits of lead ore in lime formation, many of them actually measuring 50 feet in width. The ore is of the galena and carbonate of lead variety, and I have made assays of this ore that ran as high as 20 ounces in silver and 74 per cent. of lead. One of these assays was from a sample of galena ore from the Bonnie Blue Belle mine, now in process of being patented. Another sample, cerussite, or carbonate of lead, ran 41 ounces of silver and 60 per cent. of lead per ton. I take this to be only an average sample of the vein, which was 28 feet wide, of a solid lead ore.

The obstructions in the Pend d'Oreille river alone keep Metaline district from affording a field of mineral development and building up industrial enterprises only equalled by those of Colorado, where like deposits exist.

OTHER RESOURCES OF STEVENS COUNTY.

Stevens county with safety could rely upon other resources than her treasures of precious metals. Coal has been found along the Calispel river; also along the shore of the Pend d'Orielle, a vein of bituminous coal, three feet in width, has been opened and looks most promising.

DEPOSITS OF SLATE.

Two miles north of Colville a fine deposit of slate has been found which the Washington Slate Company owns. J. B. Slater, prosecuting attorney of Stevens county, is president of this company. The deposit was located in 1889 by J. C. McFadden, J. H. Young, J. B. Slater and R. B. Thomas. The deposit is 300 feet wide upon the surface and has been stripped in many places. The slate is a good merchantable slate of the dark blue and purple varieties. Squares of slate have been extracted from the quarry 3x3x1 feet in dimensions, a demonstration of the extent and worth of this great

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deposit. The slate is admissible of a high degree of polish, in fact can be made to be as smooth as glass. This company, after an expenditure of much money, is about ready to commence the shipment of its slate to market this spring.

MARBLE QUARRIES.

Four miles east of Colville is to be found another resource of Stevens county, and one that I consider of practically incalculable value—a marble quarry. This vein of marble, running northeast and southwest, is over 500 feet wide, and can be traced a distance of more than three-quarters of a mile, cropping at the surface. This marble is possessed of every variety of color known to geologists. Both architectural and sculptural marbles in this great quarry abound. The company owning this property has expended over $8,000 in its development during the past year.

The company has a good wagon road from the quarry to the Spokane & Northern railroad, and will operate on a large scale this coming summer.

There are several other fine marble ledges in the northern part of the county, but little development work has thus far been done upon them because of their isolation from rail or water transportation to markets where the product could find an outlet and consequent sale.

ARENACIOUS SANDS.

Still another Stevens county resource, and one I think that in the future will be a prominent factor in its attainment to wealth and importance, are its arenacious sands, granulated marble or carbonate of lime. This material has been used throughout the country as a finisher for interior walls, rivaling calcimine in the purity of its whiteness.

In Spokane Falls all the principal buildings have had their interior walls dressed with Stevens county arenacious sands. There is an immense deposit of this sand about four miles northeast of the town of Colville, in the Colville mining district, and still another six miles south of the Little Dalles, on the Spokane & Northern railroad. Both these deposits have undergone developments, and good shipments of their product sent to various markets where it has always found a ready sale, once its merits as a natural calcimine become known.

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A MOUNTAIN OF IRON.

Twelve miles south of Colville and four miles east of the Spokane & Northern railroad, is a veritable mountain of iron. An analysis of the surface iron, which by the way is a red iron stone or hematite, gave the following results when subjected to treatment by me in the state laboratory: 50 per cent. metallic iron, 4 per cent. silica, trace manganese, trace sulphur, no phosphorous.

Near Chewalah, I am informed, an extensive deposit of pottery clay has been unearthed. The limited time at my disposal precluded all possibility of my visiting this deposit. I am, however, in the possession of samples, sent the state laboratory recently, and while I have as yet not treated them, their appearance warrants me in believing them to be of a high order of merit.

With this brief resume of the mineral wealth of Stevens county I will close, urging upon you the absolute necessity of making her riches tributary to our state, by the arrangement of such transportation facilities as will scatter it broadcast over the land.

MINES OF SNOHOMISH.

Let no one be possessed of the idea that all the mineral wealth of Washington is to be found, as Western Washingtonians put it, "over the range" and in the eastern part of the state. If so possessed, let him cast aside the idea, for from personal investigations I come prepared to prove it fallacious in the extreme. I admit that the development and output of our mineral wealth has, in the main, been transacted and produced over the Cascades. But I assert from evidences that have come under my notice since I assumed the office of state geologist, that incalculable wealth lies hidden in the state amid the dense forests, mountains and valleys in what we are wont to designate the great Sound country. Let me, briefly as possible, and yet do the subject justice, which I feel it merits, refer you to some of the known mineral divisions of the great Sound country. I will not admit their name is legion, but will try to demonstrate that they are as worthy the attention, first of the pros-

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pector, then of the mining operator and capitalist and seeker after profitable investments, as are such divisions elsewhere in the state.

PRECIOUS MINERALS OF SNOHOMISH.

I will first review the mineral wealth of one of our principal counties bordering on Puget Sound, well known as a lumber and agricultural producer, but one I feel is destined at no distant day to attract attention because of the wealth of precious metal beneath its fertile soil. I refer to Snohomish county, a division of the commonwealth, bounded on the north by Skagit, on the south by King, on the east by Okanogan, and on the west by the waters of Puget Sound. Here exists mineral wealth of sufficient quantity to warrant much more attention in the future than has been accorded it in the past. From a mineralogical standpoint, Snohomish county is divided into four separate and distinct mining districts. It is an historical fact that years ago gold was delved from the Snohomish soil with the assistance of those primitive utensils of the prospector, the gold pan, rocker and "long Tom." As far back as 1873, gold bearing quartz ledges carrying pyrites of iron, were discovered. About the spring of 1882, a syndicate composed of enterprising and venturesome citizens of the county endeavored to successfully operate these ledges by the crude and primitive plan of the Mexicans, known as the arrastre mill. But the ores contain sulphide of iron and lead, and the operators being possessed of but little experience, their efforts proved futile; to my mind as much from the hardships and expense incident at that early day in getting their supplies and working material to the ground as anything else.

A few years ago a small shipment of ore was made to Denver from the mines on what is known as the Silver Creek district, and gave returns of three hundred and fifty (350) ounces of silver and thirty (30) per cent. of lead per ton. This caused the Denver smelting works to send an expert to purchase the property. He arrived late in the fall, deep snow preventing him from viewing the prospect. The report he gave, however, was very flattering, and has done much toward placing Silver Creek district in the position it occupies to-day.

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SILVER CREEK MINING DISTRICT.

This Snohomish county mineral division is located in the eastern part of the county, and takes its name from a beautiful stream of water of that title, which flows westerly from the summit of the Cascade mountains through a canyon a distance of eight (8) miles into the north fork of the Skykomish river. The main creek is fed by numerous small creeks running from the silver belts through deep canyons. From the source of Silver Creek to its mouth is one continuous mineral belt. The geological formation of the Silver Creek country is porphyry, granite and diorite slates; well defined and unbroken ledges of galena (a combination of lead, gold, sulphur, silver and iron) can be traced for great distances on the surface. In my official capacity I visited Silver Creek district. I inspected over thirty (30) ledges. Some of the galena ore I found carried arsenical iron and ran very well in gold. Among the principal mines inspected were the Blue Bird and Vandalia properties.

THE BLUE BIRD MINE.

This I found to be a promising property if properly developed. It is situated in the Silver Creek mining district, and is the property of Mr. L. F. Leslie of Seattle. The ore is a galena and the vein is twenty-seven (27) feet and six (6) inches in width, with a pay-streak twenty-four (24) inches in width. I measured about one hundred and fifty (150) tons of ore on the dump, and samples I took from there returned fifty (50) ounces of silver and forty-eight (48) per cent. lead per ton. Development work consists of a tunnel driven one hundred and fifty (150) feet to tap the vein at six hundred feet below the surface. A continuation of this tunnel would tap a vein, that of the Vandalia mine, also owned by Mr. Leslie. Both these properties, after proper development, and under experienced management, would become great mineral producers.

THE NATIONAL MINE

Is another good Silver Creek property, located on National mountain, in the northwestern part of the district. This is a gold and silver proposition, the ore being an arsenical iron. The ore would probably have to be roasted because of the presence of the large

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amount of bases in the ore. The altitude of the mine is almost four thousand (4,000) feet above sea level. The vein is nearly vertical, having an eastward and westward trend. It is three and one-half (3½) feet wide and lies between porphyry and granite. Development work on this promising property, as seen by me, is as follows: A shaft twenty (20) feet in depth has been sunk through ore one hundred (100) feet below the apex of the vein; a level has been driven at considerable cost to a depth of seventy (70) feet, tapping the ore ledge. On the dump, at the time I saw the property, were seventy-five (75) tons of good looking ore. Assays taken from this dump yielded seventy (70) ounces of silver and one and six-hundredths (1.06) gold per ton (2,000 pounds), making a valuation of one hundred and ten ($110) dollars per ton. Some beautiful specimens of marcasite (or white iron pyrites) were obtained by me from this property, and are now on exhibition in the state cabinet of minerals in my office.

THE JASPER LODE

Is a fine looking property in Silver Creek district, located at an altitude of four thousand (4,000) feet above sea level, on the western slope of National mountain, on the north part of Silver Creek. The vein in this mine is also nearly vertical, having a trend to the eastward and westward. A vein seven feet in width has been developed with a pay-streak twelve (12) inches in width showing quartz and galena. A vein tunnel twenty-seven (27) feet long has been driven through ore. On the dump when I saw the mine were about thirty (30) tons of ore. Assays taken from samples of ore obtained from this dump returned one hundred and thirty-eight (138) ounces of silver and forty-four (44) per cent. lead, making this ore worth about one hundred and seventy-five ($175) dollars per ton.

THE MORNING STAR MINE,

A Silver Creek discovery, is located at an altitude of four thousand one hundred (4,100) feet above the main stream of Silver Creek. A vein four and one-half feet in thickness, carrying silver and galena ore, has been developed on this likely looking property. Development work, when I last inspected it, consisted of a tunnel which had been driven a distance of sixteen (16) feet. I understood it to be the intention to continue this tunnel an indefinite

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distance. On the dump I noted twenty (20) tons of a fair grade of ore. Procuring in the neighborhood of one hundred (100) pounds of this ore, I assayed it with the following flattering result: silver, forty-one (41) ounces; lead, forty (40) per cent.

THE TRADE DOLLAR MINE

Is, in my opinion, as good a property as there is to be found in the district. This mine is situated at an altitude of almost two thousand six hundred (2,600) feet above sea level. The ore is a smelting proposition. The vein is four (4) feet in width, of galena ore, carrying iron sulpheretts. On the claim is a drift fifty (50) feet in length driven on ore. Twenty tons of a very fair quality of galena I found on the dump at the mouth of the drift. Procuring samples of this ore, I assayed them with the following results: silver, forty-seven (47) ounces; lead, sixty-three (63) per cent.

Among other promising but as yet undeveloped properties in Silver Creek district I noted the Annie, with a vein of gold quartz ore four (4) feet in width, the Minnehaha, with a vein of silver galena ore six (6) feet in width, the Wisdom, Harrison, Billy Goat, Morton and Grover Cleveland. These latter in more or less stages of development.

THE MONTE CHRISTO DISTRICT.

This district adjoins on the west the Silver Creek district of which I have just written. It was here that, years ago, the first discoveries of precious metals were made in this Snohomish county. The Monte Christo district encompasses the Cascade range division at this point. This section is thrice bi-sected by as many arroyos or ravines, the courses of which are toward the north and south. In northwest and southwest directions these arroyos or ravines to which I have alluded are cross-cut by ledges of ore. On some of the bald cliffs and crags in this badly cut up country, surface croppings of these ledges are visible to the naked eye for hundreds of feet. These ledges range in width from four (4) to twenty-five (25) feet, and the pay-streaks in them appear to be of more than ordinary dimensions. It is my opinion, that when better and

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cheaper transportation facilities have been given this section, an increased amount of attention will be given it by mining men.

SULTAN RIVER DISTRICT.

This district, mainly a placer camp, but within which several promising ledges have been discovered of late, lies west of the Silver Creek district, bordering on the Sultan river, a beauteous mountain torrent from which this district, the third most important in Snohomish county's mining districts, takes its name. As I have stated, it is but recently that quartz carrying gold and silver has been discovered in this district. As yet, comparatively nothing has been done in the way of developing these discoveries, so that but little may be said at this time concerning them. I have seen in the possession of other persons very likely looking gold and silver bearing quartz from this district. As thus far my report has dealt mainly with metal bearing quartz, as far as descriptive matter concerning mines and mining is concerned, I do not care at this portion of it, to digress concerning Sultan river placers. I will, in consequence, refer you to my specially prepared resume of placer mining, embracing work in that direction throughout the state.

In concluding, I might add that from all I can hear, coupled with personal inspection of the mineral districts of Snohomish county, that were adequate transportation facilities accorded them, they would speedily be heard from. Despite the fact that they all are, as you may say, completely isolated, the richness of the deposits has become known, and happily, to capitalists ready and willing to undertake the work of thoroughly developing these with unlimited expenditures of money. In point I mention Monte Christo district in which certain properties have attracted attention of such men of means as J. B. Pace, the millionaire tobacco man, M. W. Dunham, and others, despite their inaccessibility.

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KING COUNTY PROSPECTS.

SNOQUALMIE DISTRICT.

In the eastern part of King county, near the beautiful falls of Snoqualmie, lies what is known as the Snoqualmie district, one recently organized. This district is the seat of one or two promising discoveries, and some time ago quite an excitement was raised over the discovery in Snoqualmie Pass of three distinct ledges of silver bearing quartz. For some reason this excitement subsided as speedily as it arose; the tin excitement in the neighborhood of Kamilchie being almost a parallel case. However, I have hopes that whenever more plainly lucrative fields have been filled, this Snoqualmie district will be given that thorough overhauling which such geological formation as is existent there certainly deserves.

THE CLE-ELUM DISTRICT.

This district lies on the east side of the Cascade mountains, in the far west portion of Kittitas county. Much can be said of this the only important seat of mining operations in the Cascade mountains. I believe what is popularly termed "The Cle-Elum" to be one of the most prominent mineral divisions the state possesses, from the very fact that the formations there are correct, and that there is every indication of the presence in abundance of the precious metals. Like all the state's best mineral divisions the Cle-Elum is hindered from coming to the front because of its inaccessibility, and it is a well known fact that this cause has proven fatal in many instances to the successful development of some of the very richest properties ever encountered. I have personally inspected the Cle-Elum district, and I admit the hardships of the journey, because of the peculiar topography of the country, are in themselves enough to keep capital out of the district until better transportation facilities are afforded.

The Cle-Elum though old in years is an infant, so to speak, so far as the development of its mineral resources are concerned.

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There are undoubtedly existent there bodies of both gold and silver ore, but the prospectors who have visited the district, seem to have devoted their time to the task of ascertaining the riches of alleged placer diggings along the banks of the river of the same name, rather than to investigating the character of the formations in the district.

THE PESCHASTIN DISTRICT.

This pioneer district, as is well known, lies in the northwestern portion of Kittitas county, and embraces all that area about the headwaters of the Wenatchee, Icicle and Peschastin rivers. It is a large district, and when first organized a thickly populated one. It is essentially a gold quartz district. Several quartz ledges in the district have been worked with the aid of stamp mills and arrastres with considerable success. One promising property that I fancied on my last visit to the Peschastin district was the Donahue mine, owned by Mr. O'Donahue, a practical miner and millman. At present primitive methods known to quartz milling of the earlier times are in vogue in the treatment of the ore from this mine. Mr. O'Donahue used an arrastre for the crushing of his rock, yet despite this fact, returns are astonishing. As the Donahue mine's output is, in my opinion, a fair sample of the higher grade of Peschastin district rock, some idea of the value of the deposits in this district may be obtained when it is stated that during the past season the Donahue output, worked in the primitive arrastres, yielded the snug sum of $17,000, and at a loss of 50 per cent. of the metal.

THE CASCADE DISTRICT.

I consider the Cascade mining district, isolated though it is from the outside world, a coming mining district in Washington. This district is the most northern mineral division of the state, being at the extreme headwaters of the Cascade river in Skagit county. It was this district and the discovery of rich bodies of ore there that

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created the intense excitement among mining men the past summer, and caused hundreds of gold seekers to brave a hazardous journey in the hunt for gold. It is in this district, too, that is located the property which Mr. J. F. Wardner, the well known Fairhaven capitalist, sold to eastern parties for $150,000 last fall.

There are two splendid properties already well developed in the district. One of these, the Boston, is the mine I referred to above as having been sold for $150,000. Still another is the Quien Sabe, located near the Boston. Some very rich ore is on the dumps of both mines, but the rigor of the past winter has precluded their working until the coming spring. Samples of ore I received from both these properties gave results as follows: From the Boston, a heavy galena ore producer, 125 ounces of silver and 60 per cent. lead. From the Quien Sabe, a galena producer also, 62 ounces of silver and 58 per cent. of lead per ton. The Rouse brothers of Fairhaven, and Harry Frank of Tacoma, are interested in these mines.

MISCELLANEOUS.

At the base of Mount Rainier, on the west side of the Cascades, through the Olympics on the head waters of the Cowlitz, and on the head waters of the Yakima, and from a new mining district on the Natches river, a great many specimens of gold, silver, lead, copper and iron ores have been sent me.

In concluding my report on the mineral wealth of our state, I ask, after the representations I have made to you concerning it, can you horoscope the measure of its greatness as a treasure box of nature? I am firmly convinced that the most neglected resource of our great young state is in the future destined to make of it what it will be, a bright star in the constellation of the wealthy commonwealths that go to form our Union.

OF PLACER DEPOSITS.

Possibly no stronger corroborative proof of the existence of gold and silver metals in nearly every section of Washington could be found than the fact that surface deposits of gold are to be found in

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twelve out of the state's thirty-three counties; this number being as widely scattered from one another almost as is Okanogan county apart from Pacific. An area of the state extending from Skagit and Okanogan counties clear to Douglas and Pierce is known to contain these surface deposits of the precious metal, and wherever it has been found, and effort made at its extraction, results have invariably been of such a character as to warrant continuance of operations.

In placer mining in this state only the most primitive methods are employed in the extraction of the precious metal, operations being solely confined to those rude contrivances termed ground sluicing, sluices, rockers and long Toms, such as were used in California in its early days. Yet even by these simple and superannuated methods, heavy yields have accrued to placer miners here, and I am firmly convinced that were appliances of modern days, the system of hydraulic mining, for instance, in vogue in California, applied to Washington placers, the results would be simply enormous.

It was away back in the 60's that gold was found on the surface away up on the headwaters of the Skagit river, and the greatest excitement was incident to its discovery. Miners flocked to what was looked upon as the new El Dorado from all over the coast, promising California fields being even deserted in the rush north. The Skagit placers proved immensely remunerative, and were worked successfully for years.

At about the same period placers were discovered on what is known as Rock Creek, in Okanogan county, and along the banks of the Similkameen river and its tributaries. As keen an excitement was raised over these discoveries as characterized those made at the headwaters of the Skagit river, to which I have just referred. Even at this late day these Rock Creek and Similkameen placers are being worked, and with good results. These placers appear to me to be practically inexhaustible, and I would not be surprised to see even better results accrue from operations in progress on them than have yet resulted.

The fame of the Cassimer bar, that placer at the mouth of the Okanogan where it empties into the Columbia, is well known. These diggings were discovered at about the same time that gold was found on Rock Creek and the Similkameen and its tributaries. An immense quantity of gold has been taken from Cassimer bar,

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and operations still continue, the mongolian element deriving the benefit accruing from them, as, indeed, I found to be the case all along the Columbia river, wherever placers are existent.

A dozen or more years after these discoveries the now famous Swauk, Peschastin, and Cle-Elum placers, all in Kittitas county, were discovered, and as demonstrative of the area covered by them, I may state that these have been worked continuously and with great profit from the day of their discovery. Along the Swauk, several nuggets of pure gold, running in value as high as $400 each, have been found, and splendid samples of the wealth of these Swauk placers are to be seen in the banking house of Ben. Snipes & Company, in Ellensburgh.

From the last three districts I have named, the output annually has approximated at least $100,000; indeed I believe this an underestimate. My researches, directed in an endeavor to ascertain the output of these placers were attended with difficulty, I finding it absolutely impossible to get entirely accurate data.

Along the Columbia river from the British boundary line to the mouth of the Okanogan, there are many placer miners at work washing gold. One company values its possessions to such an extent as to warrant it in commencing the construction of a ditch which will cost at least $36,000, and will be used as an aqueduct for the conveyance of water to their claims.

On the western side of the Cascade range on the Sultan river, in Snohomish county, the Sultan River Mining company has expended at least $30,000 for the construction of tunnels, ditches and flumes, development work preceding operations on the rich placers of which it is the possessor.

The character of the Washington placer output is a coarse gold. Wash or flake gold is unknown in these placers, the output being a metal of singular purity and brilliancy. On Sullivan Creek is this fact strongly demonstrated, as I have shown it to be in the Swauk, Cle-Elum, Peschastin, Sultan river and other placers to which I have alluded.

On Sullivan Creek are some fabulously wealthy placers. This creek is situated in the northeastern portion of Stevens county. The creek has its source in a high range of hills west of the Pend d'Oreille river, and flows southwesterly, emptying into the Pend d'Oreille a mile above the big falls near the town of Metaline. In winter this stream is a raging torrent, and impossible to ford.

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On account of this fact placer mining along the stream is suspended three months out of the year. The stream becomes docile early in the year, and then the work of extracting gold from the rich placers lining its banks is proceeded with in earnest by scorces of miners, its waters being utilized for washing purposes. From these Sullivan creek placers many nuggets of a value of $20 each have been found. In fact I have been informed that such discoveries are a common thing. From personal investigation of these placers I believe these statements not the least exaggerated, as I saw any number of nuggets of that and even greater value. The output of these Sullivan creek placers is a coarse gold of finest character. These placers have been mined almost continuously for a quarter of a century, their output averaging all the way from $8,000 to $10,000 annually. I found several miners at work on the occasion of my last visit, and the labors of all I ascertained were being well rewarded.

On a recent visit to Spokane Falls, I had the pleasure of viewing the magnificent collection of golden nuggets and gold of other character taken from placers. I must confess I envied the possessor his splendid collection, and bethought what an addition it would make to our rapidly growing exhibit of the mineral wealth of Washington.

I look upon these placers as a prominent factor, not alone in the upbuilding and development of our state, but in its sustenance as well. It is a well known fact that Washington, while a territory, relied greatly on her placer mining output for her support, or at least for substantial aid, and to-day these placers I know to be materially aiding the country. For a quarter of a century the diffusion of wealth through the state has been largely augmented by them.

OUR BUILDING STONE.

It is my firm belief, that from an architectural standpoint, the country is passing through a stone age. I am sure that you will agree with me that at least our state is. Even in residence construction, and despite the fact that here in Washington lumber is more plentiful, and can be procured at less cost than in any other

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state west of the Missouri river, lumber, as a construction material, is fast giving way either completely or in major portion to stone. I offer as an example of this fact the numberless business blocks, public buildings and other institutions scattered throughout the state in which the principal material used in construction is stone.

As usual, our bountifully endowed commonwealth rich in everything, is wealthy in the possession of the finest building, dimension and rubble stone, of nearly every known variety from the finest of marbles to the sturdiest of granites and sandstones. These are to be found scattered all over the state, from the north to the south and from the east to the west, and there has scarcely passed a week since I assumed the duties of this office, that I have not been apprised of the discovery of some deposit of dimension stone; and I may say here, that out of over forty samples sent me to the state laboratory, in not a single instance did the stone so sent prove of a character useless for building purposes. Where less than six years ago Washington boasted but few stone quarries, they may be found to-day all over the state. Prominent among them are producers of a superior sandstone of buff, bluish gray, and olive green colors and other varieties. Various granite and marble quarries have been discovered since I took office, and are being developed as rapidly as circumstances will permit. Samples of these granites and marbles sent me showed them to be of excellent quality. The granite I found to be close grained, free from sand-streaks and shakes, mottled with a uniformity and picturesqueness remarkable and capable of standing a high degree of polish. The marbles I have described in a previous chapter, but I may add here, that in all my experience, I have never seen such a diversity of color in marble, and such capability of all hues to stand treatment and polish as those found in this state.

To demonstrate the strength and durability of the dimension or building stone found here, I treated samples in the following manner:

My first task was to ascertain with the aid of my analytical balance the specific gravity of a sample of sandstone from the Chuckanut quarries in Whatcom county. A rough cubical specimen of this sandstone weighing about 100 grammes I dried at 100-c. to a constant weight (5 days) weighed in the air, and then weighed after prolonged immersion in water suspended by a horse

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hair. The weight of the dried cube, divided by the loss of weight caused by its immersion in water, was taken as its specific gravity. One cubic foot of this sandstone's weight I next calculated from the weight of a cubic foot of water which is equal to the weight of 62.4 pounds, that being the weight given by Professor Rickett, geologist in the Columbia School of Mines. My next effort was directed toward a determination of the crushing strength of the rock. I used a government machine of 100,000 pounds. The absorption of moisture was next determined. My determination of the absorption of moisture was successfully conducted by carefully drying roughly cubical fragments in a water vapor, saturated atmosphere for fifty-one days, these cubes being of 100 grammes weight. The cubes I placed under a jar over placid water and on a shelf of glass. For a second test I took an equal weight of the samples and placed them in a vessel of water for five days. After immersion for the above length of time, they were dried carefully and their weight thereafter represented the amount of moisture absorbed by them during their immersion. To ascertain the carbonic action on the stone, I drowned a similar weight (100 grammes) in water in a carbonic acid solution.

After this treatment, I was pleased to find that the loss of weight was inconsiderable. It was a practical demonstration to me of the worth of our sandstones. But, desirous of using all of the arts known to my profession and irretrievably establishing the quality of the stone, I determined to ascertain the weathering and the staining effects that could be developed within the period (51 days) during which I gave the samples their airing. This was to approximate what could reasonably be anticipated of our sandstones used for building purposes as regarded the maintenance of their natural color. I noted the effect of a dry heat upon my samples by placing the cubes in my muffle furnace and subjecting them to a red heat. Raising the heat, I gradually made it a full redness. I noted no softening or cracking after they had undergone this ordeal. I plunged them while subjected to this heat in a bath of cold water, and the only perceptible change was a slight corroding of the surface. I do not mean to assert that the tests I gave these sandstones is incontrovertible proof of their value as building stones, but ask of any accredited geologist if he has ever had or heard of better results being obtained than those I got from tests of Washington stone.

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As a result of this test, I append the following summary:

Specific gravity	2.57
Weight per cubic foot	160.62
Absorption moisture	1.35
Absorption water	5.342
Loss on exposure to carbonic acid gas solution	0.18

Exposed to acid fume, the stone was stained a greyish yellow in spots. It became loosely adherent on the surface and through quiet integration lost 6.13 per cent. of its weight, and by friction an additional loss was incurred of ten per cent. I found after treatment in my muffle furnace a change of color, from the green to a greyish hue. I could not, after giving the samples a full red heat, develop a single flaw, nor could I develop this after immersing them while hot in water, barring the corroding of the face of the samples to which I previously alluded. In determining the strength that would crush these samples, I used cubes 1.715x1.755 in x1.650 in (h. t.) for bed; and 1.390 in x 1.250 in x 1.150 in (h. t.) for edge; resulting in 10.321 pounds per square inch for bed; and 8.100 pounds per square inch for edge. Is not this a truly excellent showing, when I mention the fact that these samples I obtained from as near the surface as possible.

These tested samples which so heroically withstood the severest trials known to modern science, are from quarries the product of which may be seen to-day, beautifying and rendering impenetrable to wear and tear and march of time all our finest structures.

So engrossed has been my whole attention with the work of properly outlining and classifying the duties incumbent upon me, and so deeply have I been engaged in ascertaining the worth of the possessions of the state from a mineral standpoint, that I have had during my brief incumbency but little time to devote to the subject of which I have written. I hope this coming year, however, to be able to thoroughly and exhaustively refer to the wealth of our state's stone quarries, and especially enter into the quality of the granites, sandstones, marbles and other valuable formations of like character, which I know are abundant within her boundaries.

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LIMES AND MARBLES.

Equally valuable and important among our possessions, in my estimation, is the state's practically unlimited deposits of limestone, that great factor in the production of what you must concede to be one of Washington's greatest industrial items of manufacture—lime. Imagine an area ninety miles in length and fully twenty in width of almost solid and unserried layers of limestone. This statement you may deem incredible. So did I. Visit our county of Stevens and your incredibility will certainly be dispelled as was mine. I find limestone deposits existent in phenomenally large proportions in many localities of this state. Prominent among them are Stevens, Skagit, San Juan, Island, Okanogan, Whatcom, King, Pierce, Douglas and Kittitas counties. The pecuniary value of a limestone is its ability to be resolved into that absolutely necessary requisite in architectural construction—lime.

I have demonstrated beyond a doubt to myself that nearly every known limestone deposit so far discovered will make a quality of lime unexcelled. My analyses of about forty samples of stone from nearly as many different localities, has practically and thoroughly demonstrated to me this fact.

I have ascertained, through facts and figures that will not admit of publication here, that the growth of home consumption of home manufactured lime has been actually phenomenal within the past twelve months. Indeed, with a home production of this article excelled in proportion by no other lime producing state on the Pacific coast, so great has been the consumption that I consider it really unnecessary for me to present facts and figures concerning either it or the exportation or production of this article. As an example of the proportion of the latter, allow me to state that one lime manufacturing establishment alone is at this writing producing per diem thirteen hundred (1,300) barrels of merchantable lime, and the demand exceeds the supply by thirty-five (35) per cent. I refer to the state's great lime producer, the Tacoma & Roche Harbor Lime Company, whose thirteen (13) patent kilns in San Juan county are being now operated night and day. I would also call your attention in justice to the energy and enterprise of the gentlemen operating them, to the many kilns in constant opera-

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tion, of the most improved design, in Stevens, Okanogan and other counties.

I would do an injustice to every manufacturer of lime in this state did I not make mention of the wonderful strides they have made as regards the keeping abreast of the times in the matter of using the most approved methods, no matter what the cost, in the production of Washington lime. I have found, on personal inspection, this to be the fact. Patented and approved kilns I found everywhere in use, and a little dissertation between the old and new kilns used in burning lime I do not consider out of place; in fact, on the contrary, I believe would be of great interest to you. The older style of burning lime in the old "pot" kiln I deem it unnecessary to describe. The new and modern kiln, and the one I find to be nearly universally in use here in Washington, differs so materially from the old "pot" structure that you can continually fill and draw from it the lime, thus expediting the production of the article and lessening the cost of such production. The production of lime, I have ascertained, has been increased nearly fifty per cent. since the introduction here of these patent kilns, it taking but fifty (50) hours for the lime to be put through the new kilns, whereas as much as four days were necessary with the old "pot" kilns.

As illustrative somewhat of the importance and growth of this great industrial enterprise, and, as well, the purity of the limestone, the raw material in the manufacture of its product, I append the following companies, prominent in the manufacture of lime, with an analysis which, in my opinion, speaks volumes for the worth of the article they manufacture:

Tacoma & Roche Harbor Lime Company; Pacific Lime Company, Island county; Broughton Lime Company, Okanogan county; Hunter Lime Company, Island county.

Lime from the Olympic, Weenatchie, Cle-Elum, Skagit, Stevens, King and other localities. Samples of all the above companies' deposits have been tested by me in the state laboratory. (See table on next page).

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TABLE OF LIME ANALYSES.

Elements.	*Tacoma & Roche Harbor Lime Company*	*Govt. quarry, Okanogan county*	*Pacific Lime Company*	*Broughton Lime Company*	*Snoqualmie Company*	*Skagit lime*	*Cle-Elum*	*Stevens*	*Kittitas*
Carb. of lime	98.21	97.13	96.70	96.30	98.34	96.50	97.50	98.00	95.30
Silica	.04	2.30	1.50	2.30					
Manganese	1.01		1.40						
Iron				.80					
Magnesia		.10							
Phosphates	.01								
Water	.73	.47	.40	.60					
Carb. organic									
Total	100.00	100.00	100.00	100.00					

AS TO MARBLES.

Properly following my report on limestone and lime, I deem a brief statement regarding marble in Washington apropos. The development of Washington's marble wealth has been as yet of but infantile proportions, and in consequence but little can be said of it. However, I am prepared to state that samples that I have seen and tested have compared most favorably with the many fine Italian and Vermont marbles, both of the sculptural and architectural varieties, which have come under my inspection during several years past. I have seen Washington marble of close texture, variegated and of beautiful hue, and which I have found to be admissible of the finest polish, dress and tool work. Especially pleasing to my eye and of value, in my opinion, were samples sent to the state laboratory from the Skagit and Stevens counties.

To me it was likened to the high class marble for which sunny Italy is famed, as well as our own state of Vermont. The Skagit product I class a dolomite with hard and fine grain and strength, admissible of a fine polish, and it is a durable and beautiful variety of the handsomest stone formation known to man.

Quantities of different species, many of them of rarest beauty, have been found in Stevens county, where, I join in a congratula-

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tion I feel you will experience over the fact, that a full-fledged, prosperous and progressive marble quarry and manufacturing equipment is in operation to-day. Many of these samples I have mentioned were the pure white, a white clouded with gray, and a grayish black, finely mottled with white. The majority, however, were of the clouded white variety, and tests made by me, which are appended, are, therefore, with special reference to this last named variety.

I made first a microscopical examination of the Stevens county grayish black marble. The examination proved highly interesting. From it I pronounced it to be hard and very strong. My samples, when subjected to the treatment, took splendid polish, assuming the smoothness of glass shortly after the application of ordinary marble polishing materials. Duller granules, which I have heard complained of in this stone after attempts at polishing it, I find can be dismissed if the polishing process has been done in a workman-like manner known to artisans used to this work.

Next I put my samples under chemical treatment. As a result, I found that they contained about 7.80 per cent. of carbonate of magnesia, and another microscopical examination demonstrated the fact that two different kinds of granules made up the stone, with different degrees of hardness.

This observation, taken together with the fact that a residue remained after putting the marble under treatment with cold dilute hydrochloric acid, which residue was easily soluble in hot hydrochloric acid, established the fact beyond peradventure that the Stevens county marble is a dolomitic limestone and consists mechanically of a mixture of calcite granules (carbonate of lime) and dolomite granules (double carbonate of lime and magnesia). The mechanical mixture of the two kinds of granules, by scratching the surface and applying a drop of cold dilute hydrochloric acid, could be plainly seen by the naked eye. The calcite granules are left in relief. A further residue insoluble in the acid exists. I find the cause of the clouding of what would otherwise be a marble of snow-like whiteness to be due to graphite scales. The greater number and greater proximity to one another of the graphite scales, the darker the coloring. Graphite scales very thickly scattered through the cleavage of the Stevens county greyish black variety are accountable for the mottled appearance of that stone. I have seen in the purest white marble small scales of graphite which with-

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out the aid of the microscope would have remained undiscovered. The specific gravity of the samples tested by me, and other interesting information concerning these tests, I append: Specific gravity, 2.69. Weight of one (1) cubic foot, 168.12 pounds. Also, the proportion of water is 0.15. The loss in carbonic acid solution after long exposure amounted to 0.94. When I heated my samples in the muffle, aside from an increased whiteness like that characteristic of limestone under the same treatment, I could observe no change in the marble. When under the effect of a full red heat I noted the appearance of the marble change to a mottled color, and shortly afterwards was not surprised to see the marble act identically with limestone under like conditions. That is, it began to crack on the surface and edges, but the cracks penetrated but a little distance into the interior of the sample. Withdrawing the sample from the muffle, I immersed it immediately in cold water. The result was simply a corrosion of the edge and cracked surface, thus clearly establishing in my mind the general strength and worthiness of the marble for architectural purposes. I next determined, with the aid of a government machine, the crushing strength, using a bed cube, 1.525 inches x 1.540 inches (ht), giving 16,992 pounds per square inch. And on an edge cube 1.369 inches x 1.339 x 1.420 inches (ht), giving 16,102 pounds per square inch.

I think these returns a practical demonstration of the value of the marble. I have had but little time to devote to this particular study, but purpose during the year inquiring exhaustively into it, and if occasion demands of filing a supplementary report on this important subject.

MANUFACTURING CLAYS.

As different in character even as Washington's superb resources are her enormous deposits of clays, and as the modern demand for building clays is, and bids fair to continue to be, enormous and perpetual, I rank among our most generous gifts from nature our possessions in the way of clays capable of being manufactured into material suitable to the uses of artisan, decorator, potter, in fact, all known craftsmen from a builder down. Therefore most particular I have been in my investigations into the character, values and domain of these deposits.

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My investigations, continued at every opportunity from the date of my commission as your state geologist, I must say have been resultant in facts concerning Washington clays of a most flattering description. In brief, I might say that in all my experience, and in all my inspections of like nature made abroad, I have found no such wealth of useful clay and in such striking, even singular variety, as I have aided in unearthing in Washington, and developing and calling to the attention of the manufacturing fraternity here and elsewhere.

A classification of these clays I give in support of what otherwise might be considered by the skeptical too flattering an encomium to what is really one of the state's most promising resources of today.

In Washington are to be found many distinct varieties of clay, which properly treated, may be made to become merchantable and always, in these times, marketable products of the manufacturer. Among the most important I may mention clay for brick, both pressed and rough, of the finest quality, as you may see by that in use throughout the state, all of home manufacture.

Clay eminently well suited for the making of fire brick, the most valuable of all classes of brick, and for the Washington product of this character, I am glad to be able to say there has the past year sprung up a keen and growing demand.

Clay suitable to undergo the treatment of the potter, and be rendered into forms of usefulness peculiar to his art.

Clay that has been practically demonstrated to be the very best for moulding into building ornamentation to be found on this coast.

Clay, that given proper treatment, may be transferred into porcelain and such ware, the like of which I know from personal investigation will equal the famed wares of the Japanese and English in superiority of its quality.

Clays for stoneware are as good, and from what I have read, far more plentiful than any deposit on this continent or in Europe.

Thus briefly have I informed you of Washington's Alladin-like resources in the regard of which I write.

CLAY FORMATIONS.

All clays are essentially silicate of alumina. As to color, they are naturally of yellow, blue or greenish hue. Pure clays are white.

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Colored clays are the result of the several admixtures of the various substances contained within them. Clay possessing a high degree of plasticity is called "fat" clay. The opposite, or a clay possessed of no plastic qualities, is called "short" clay. This state's clay possessions comprise all the varieties I have designated, and even more and new varieties, on which I am now operating, and which give great promise. Pure clay is infusible; that is to say, is not capable of being treated. But by admixture with lime, iron or other bases, becomes to a greater or less extent more kind to treatment and manufacture. Washington's clay, because of her wealth of these required bases, as you must be aware, can be thus treated at small expense. It is my opinion, developed from exhaustive investigation, that Washington pure clay can be more cheaply rendered merchantable than can a like possession of any other country on the globe. In the manufacture of clay, that which is useful for fire brick, porcelain, etc., is known as refractory clay. The more refractory a clay is the more invulnerable brick manufactured from it is to fire. Washington refractory clays I find to be more so than any that have come under my observation. They are very valuable, and I look to a rapid development of these great refractory clay deposits. The appended analysis of fire clay made by me since my incumbency in office speaks for itself more eloquently than a pen could portray.

An analysis from the Black Diamond fields, King county, stood 2760 F. before fusing.

(Analysis made May, 1890.)

Silica	57.50
Alumina	34.37
Iron oxide	1.24
Lime	.50
Magnesia	1.00
Alkalies	.68
Water	4.71
	100.00

An analysis from the Green river fields, Pierce county, stood 2831 F. before fusing.

(Analysis made June, 1890.)

Silica	69.71
Alumina	18.39
Iron oxide	1.44

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Lime	.35
Magnesia	.15
Potash	.19
Soda	.83
Lost by ignition	8.94
	100.00

An analysis from Skagit county's fields stood 2800 F. before fusing.

(Analysis made June, 1890.)

Silica	49.73
Alumina	32.57
Iron oxide	1.52
Lime	.42
Magnesia	1.28
Sulph. Lime	.10
Carb. Lime	.43
Sulphide	.47
Soda	1.10
Potash	.00
Water	12.38
	100.00

CEMENT.

It is certainly not the opinion merely, but the firm conviction of the writer that the near future will see cement among the most important of Washington's productions, her deposits of limestone and the industry of resolving them into one of the most valuable of manufactured products known to modern times.

In discussing and demonstrating the new state's resources in this regard, it might be best that I should review *seriatim* her different known belts of limestone and other raw material from which a merchantable article can be and is being made. (See article on limestone and clays).

HISTORICAL.

One of the most valuable products derived from the proper treatment of the proper limestone, as is known world wide, is cement; and the value and phenomenally growing demand for a variety

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termed the "Portland" is as well known. Washington, in my opinion, stands without a peer in the constellation of states as regards her possession of limestone deposits from which the very finest of this "Portland" variety of cement can be manufactured, and too, with signal simplicity and success.

Portland cement was first manufactured from limestone and clay and mud suited to that purpose in England in 1824. I find Washington's limestone of even finer quality than samples of the English variety inspected and treated by me in my official capacity. The variety takes its name from the very close resemblance it has when "set" to the famous Portland dimension stone so long in use in nearly all building operations in Great Britain, both governmental and personal. In the preparation incident to the resolving of the limestone and clay into Portland cement, the raw materials in mud of equal quantities are intimately mixed. This mixture next is allowed to dry in the air and then is put through the process of burning in kilns. The kilns are so arranged that alternate layers of fuel and the mixture of the mass are introduced. Coke, both here and elsewhere where Portland cement is manufactured, has been found by experience to be best adapted as kiln fuel. After the mass I have described has been submitted to a red heat, it will be found to have assumed a yellowish brown color, and at a higher temperature becomes of a dark brown hue. A white heat reached, the mass becomes grey. Now, if during the operation of manufacture these colors are shown at the several stages of treatment I have described, the resulting product of this treatment will be a cement that sets hard. A summarization of the process I have described would be: Portland cement or artificial can be made from a combination of any limestones which will make quick lime. The stone, when treated as described absolutely must make the quality of lime I have named; when treated with any material that will form a clay or mud which under a heat will result in a chemical action between the two.

LOCATION OF DEPOSITS.

In my researches in Washington's limestone possessions their location and worth, I have found existent in many localities, limestone of a quality unsurpassed for the manufacture of this valuable product.

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In conclusion, I reiterate my assertions as to the value of our state's possessions of limestone suitable for the production of the very best article of cement known to modern times, and I close with an analysis of this cement which I made, and which was produced from Washington's limestone and clays.

TABLE OF ANALYSIS.

Washington limestone and clays. { Result: Portland cement. Quality: Very superior.

Elements.	*No. 1.*	*No. 2.*
Silica and clay	27.16	25.19
Alumina oxide	9.30	11.40
Ferric oxide	2.20	3.02
Lime	52.30	53.78
Magnesia	5.67	4.28
Potash	.97	.43
Soda	2.40	1.90
Totals	100.00	100.00

CONCLUSION.

I admit that brevity is a rather prominent characteristic in my first report as state geologist. Without desiring, in fact refusing, to plead any extenuating circumstances in connection with this feature of the report, I would call your attention to the fact that no public officer of the state has the area to look over, the multifarious duties to perform in connection with his inspection of such area, that I have as state geologist; and also to the fact that this office I have conducted, and the duties devolving upon me I have performed, singly and unaided. With the hope that you will bear in mind this fact, I respectfully submit my report.

GEO. A. BETHUNE, *State Geologist.*

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ADDENDA.

ASBESTOS.

Among the most valuable deposits found since my incumbency I rank asbestos. This was recently discovered by some prospectors in Skagit county, near Hamilton, on the south side of the Skagit river. I have had no opportunity to analyse the new found mineral except to demonstrate its utter incombustibility to my complete satisfaction. The quality of our asbestos is superior, the fibres being as firm as flax and easily separable with the fingers. It is of the finest quality, and I inspected some beautiful specimens of the "mountain leather" variety. Some of the product of the mine has been shipped to the city of Tacoma, and has been manufactured into useful fire-proof paint.

GRAPHITE.

In connection with the discovery of asbestos, I would call your attention to a discovery of graphite near Fairhaven, in Skagit county. Mixed with asbestos, graphite (a carbon) has been demonstrated useful and valuable in the manufacture of mineral and fire-proof paints.

MOLYBDENITE.

As illustration of the metallic variety of substances found in the state, I would call your attention to a recent discovery of the above named rare metal. A large vein of it is undergoing process of development in Okanogan county, near the mouth of the Salmon river and its confluence with the Okanogan. I have made an analysis of this curious metal which I append herewith:

Molybdenum	54.20
Sulphur	36.19
Iron	1.20
Gangue	8.41
Total	100.00

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MICA.

This office is in receipt of what I consider some very fair specimens of mica. Stains of iron visible were accounted for by the fact that the samples were taken from the surface. These samples came from Skagit and Whatcom counties, and I think this find should be given careful investigation.

CHROME IRON.

In the Colville Indian reservation, Stevens county, a deposit of chrome iron has been found. This ore affords chromium oxide and is invaluable in the manufacture of paints. Were the reservation open, this discovery would undoubtedly prove valuable.

NICKEL ORE.

From Clallam county I received a specimen of nickel ore recently. I am in possession of no data concerning the proportions, and as a consequence the value of the deposit. The senders of the sample being desirous for the present of keeping their discovery secret.

NEW COAL FIELDS.

Coal discoveries continue to be made. Late and successful beds developed are those being worked by the Washington Improvement Company in Pierce county. Under the able management of Mr. A. L. Horner, work on this fine property progresses splendidly.

The Tacoma Coke and Coal Company, with A. C. Smith and W. H. Fife, of Tacoma, at the head, are developing a most promising looking bed of coal in the Wilkeson country, Pierce county.

Governor Will Moore and George Washington Yancy are developing a bed of superior coal in Skagit county, about six miles from Stanwood.

J. F. Wardner and others have secured a large vein of fine looking coal near Lake Whatcom, in Whatcom county, and work of development is being rapidly pushed.

PESCHASTIN'S PROMISE.

The opening of the present year looks most promising for the mines in the Peschastin district, hereinbefore alluded to. Development work is to be vigorously prosecuted, I am given to understand, on many fine prospects, including the Humming Bird, Golden

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Phœnix, Pole Pick and Culver claims. The average working value of the ores from these claims is about $37.50 per ton. Much of this ore is free milling, and argentiferous galena abounds.

SWAUK PLACERS.

The placers of the Swauk bid fair this year to eclipse all former records as regards output of the precious metal. Some idea of the purity and value of the Swauk output may be had from the appended computation, compiled from estimates of placer gold contained in the magnificent collection of Banker Ben. E. Snipes, of Ellensburgh, this state:

Sample.	*Weight.*	*Value.*
No. 1	24 oz., 13 pwts., 10 grs.	$325 00
No. 2	8 oz., 9 pwts., 12 grs.	135 60
No. 3	3 oz., 2 pwts., 2 grs.	49 66
No. 4	3 oz., 7 pwts., 3 grs.	53 70
No. 5	6 oz., 18 pwts., 4 grs	110 55
No. 6	2 oz., 18 pwts.	46 40
No. 7	Small nuggets	39 70

CLE-ELUM DEVELOPMENT.

Among the fine mines to be found in the Cle-Elum district, to which I have also referred elsewhere, should be mentioned the Silver Dump, Silver King, Madeline, Aurora, Mountain Sprite, Bald Eagle, Ida Elmore, Fortune, Cle-Elum and Hawk claims, on all of which a great amount of development work is to be done this year. Assays made by me of ores from these properties average from $30 to $45 per ton.

COPPER LOCATIONS, 1891.

Several locations on copper deposits have been made in the Cle-Elum district this early in the new year. All are promising, and a vast amount of development work is promised upon each of them by their owners. Assays of Cle-Elum copper run as high as 35 to 65 per cent. of that metal, with $40 to $53 per ton in gold and silver.

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IRON LOCATIONS, 1891.

Southwest of and about nine miles distant from Cle-Elum, between Winimik creek and Yapai creek, some thirty-four locations have already been made on iron deposits discovered there. Assays of the ore from this section run from 33 to 58 per cent. iron, with from $11 to $13 in silver to the ton (2,000 pounds). The lodes number six, are parallel, from four to eight feet in width, and are from twenty-six to thirty yards apart.

COALS OF THE CLE-ELUM.

The present year should witness the application of a great measure of development work on the coal deposits long known to be existent in the Cle-Elum country. Coals of the finest quality abound in the region, and I am given to understand that the enlistment of great capital bids fair to render resourceful this, one of the many valuable minerals to be found in the favored Cle-Elum.

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SUPPLEMENTAL.

In connection with this report, and for the benefit of the state and furtherance of the usefulness of this department, I call your attention to the following facts, all too strongly impressed upon me during my first year in office:

First: The geological department of this state, properly conducted and made capable of serving the interests — manifold and valuable as I have demonstrated them to be — for which it was devised, is hindered, and very materially hindered, from doing so by lack of sufficient funds to carry on this great work.

Second: That in the early work of this department, a work that I concede will take time to systematize, expense that possibly may not accrue in future years must of necessity now be incurred if the state derive benefit from this department and the mineral development, the fostering and furthering of which it was created to maintain.

Third: That had our last legislature realized or known of the vast area of our mineral belts, of the expense incident to their advertisement to the world through the medium of reports issued by authority of our government and for which it holds itself responsible, and, consequently, so established this department as to make its work complete in detail, much more would have been accomplished since the establishment of this department than may now be placed to its credit.

Fourth: That through the medium of this department it has been practically demonstrated that the mineral development of this state is not at a standstill, but, on the contrary, with phenomenal strides is pushing forward and that another year will witness such a growth in both area and production of mineral in Washington as will surprise even the most sanguine in the future of our greatest resources — mines and mining.

Fifth: That because of this fact, as a natural sequence so to speak, more money will be needed to carry out the purposes for which this department was formed than is now requisite.

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I have in my attempt at demonstrating the necessity of keeping apace with, fostering and furthering a resource I feel is the most valuable we possess, set forth to you what I feel you will concur with me are irrefutable facts.

I have carefully conned the situation, and I have no hesitancy as a state officer, sworn, and under bond, in requesting that the appropriation for the next two fiscal years approximate at least $25,000 each.

GEORGE A. BETHUNE,
State Geologist.

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FOR COURTESIES EXTENDED.

I desire to thank members of the press throughout the state, and among many gentlemen the following named, who have aided me materially in my researches: John M. Burke, after whom the town of Burke, Idaho, is called, now of Spokane Falls; Col. Tom Ewing, of Seattle, a gentleman of wide experience in mining; A. P. Webb, of Seattle; Col. Wheat, of Spokane Falls; Maj. Garretson, of Spokane Falls; Frank Parker, of Walla Walla; James Wardner, Col. Will L. Visscher and Gov. Black, of Fairhaven; Judge Slater, of Colville; W. Parker, of Chewalah, and Gen. Amos P. Curry, N. G. W., of Spokane Falls.

GEO. A. BETHUNE, *State Geologist.*

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ERRATA.

Page 15 — Concluding paragraph Washington coals, "Our bituminous coal contains a very large percentage" should read "a nominal percentage."

Page 37 — Assay for "magnesia" should read assay for "manganese."

Page 88 — In line ten (from top of page), "seventy-five tons of good-looking ore" should read "seventy-five tons of good-looking galena ore."

Page 88 — The Jasper lode — seventh line: The word "vein" should be omitted.

Page 94 — "It was away back in the sixties that gold was found on the surface" should read, "It was away back in the fifties," etc.

Page 94 — "It was away back in the fifties that gold was found on the Skagit river" should read "on the Similkameen." Note reference, last line, same paragraph, to "Skagit placers." This should read "Similkameen placers."

Page 102 — In table of lime analyses, "Phosphates" should read "Phosphorus."

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